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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

MICROELECTRONICS MONITOR

Issue No. 20/21 1987/I

16970

Dear Reader,

We have been looking at ways and means of speeding up the mailing of the Microelectronics Monitor to overseas countries. One possibility that was also suggested by several readers is that they purchase UNESCO coupons (IRCs) with their national currency at the local distributing agent, which as a rule will be the National Commission for UNESCO. Readers may wish to inquire into this and let us know by returning the attached questionnaire (page 62). An alternative solution for readers who are in posession of convertible currency is that delivery is done by an agent in Vienna who will charge directly for airmail plus a small handling fee. Those who might be interested in such a scheme should also indicate so on the attached questionnaire.

We are also considering accepting paid advertisements from commercial companies and using eventual revenues towards helping print the Microelectronics Monitor. We will be glad to answer inquiries from companies which would like to know more about it. The Microelectronics Monitor is published four times a year with a roll figure of 1200. It is sent to a selected clientele in some 100 countries, both developing and developed.

You will find on page 8 a review article on application-specific integrated circuits (ASICs) which is reprinted with kind permission from High Technology Magazine. The article provides an interesting overview of recent developments and trends in this sector of the IC market.

Finally, let me assure you that despite financial constraints the Microelectronics Monitor will continue to be published as our readers have confirmed that there is a felt need for it and that it is useful.

K. Venkataraman
Senior Technical Adviser
Department for Industrial Promotion, Consultations
and Technology

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Compiled by Development and Transfer of Technology Division, Department for Industrial Promotion, Consultations and Technology, UNIDO, P.O. Box 300, A-1400 Vienna, Austria.

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NEWS AND EVENTS

Trinidad workshop

UNIDO assisted the Government of Trinidad and Tobago in the organization of a Workshop on the Development of Microelectronics Capabilities, held at Port-of-Spain, 10-12 February 1987. The meeting considered a survey of microelectronics/informatics activities in the country and worked out recommendations for future development. Two UNIDO consultants, Prof. K. V. Ramanathan, IBM Watson Research Centre, USA, and P. Bastos Tigre, Instituto de Economica Industrial do Rio de Janeiro, Brazil, prepared papers on the subjects of "Policies to facilitate the application of microelectronics in the production process" and "Trends in the development of microelectronics and the strategies and policies being pursued by other countries". Both consultants also assisted in the preparations for, and discussions during, the workshop.

Policies and strategies of information technologies for development

The Universidad Natural de Colombia, Bogotá, has a programme on "research on policies and strategies of information technologies for development". For information please write to:
Prof. Carlos Cortes Amador, Calle 43A No. 78B82, Bogotá, D.E. Colombia.

International conference on informatics in medicine

The All-Union Research Institute for Systems Studies (VNIISI) hosted the International Conference on Informatics in Medicine, held in Tbilisi, Georgian SSR, USSR, from 20 to 22 November 1986. This was the second meeting of its kind and constituted a follow-up to the first, which was held at IIASA, from 25 to 27 November 1985,* entitled International Workshop on Medical Expert Systems and Social-Economic Opportunities for their Implementation in Developing Countries. Over 70 participants from nine countries devoted particular attention to the use of medical expert systems in developing countries. Co-sponsors of the Conference were UNESCO, the Intergovernmental Bureau for Informatics (IBI), and IIASA. The next follow-up meeting is planned to take place in 1987, possibly in Rome (IBI) or in Paris (UNESCO).

African regional computer confederation**

Gradual progress is being made in the formation of the African Regional Computer Confederation (ARCC) and in the establishment of its programme. Representatives of the computer societies of Kenya (Mr. George Okado), Nigeria (Prof. Sam Jaiyesimi), Republic of South Africa (Mr. Hennie Leroux), and Zimbabwe (Mr. Geoff Fairall) met during the IFIP General Assembly (GA) meeting in August 1986 in Dublin to further plans for ARCC and to co-ordinate these plans with IFIP activities on the African continent.

IFIP Trustee Leroux reported to the GA that ARCC will be divided into four regions, each co-ordinated by one of the aforementioned ARCC participants: Central African Region (Malawi, Zambia, Zimbabwe), Eastern (Kenya, Tanzania, Uganda), Southern (Botswana, Lesotho, Namibia, Republic of South Africa, Swaziland), and Western (Benin, Gambia, Ghana, Liberia, Nigeria, Sierre Leone). This division is deemed desirable, because the size of Africa creates severe problems in communication and travel.

Technical conferences in 1987 are planned by ARCC for Johannesburg, South Africa; Harare, Zimbabwe; and Nairobi, Kenya. (IFIP Newsletter, No. 4, December 1986)

France/UK videoconferencing link

The first commercial videoconferencing link between the UK and France has been inaugurated between British Telecom International and Direction General de Telecommunications, the French PTT. The connection to France consists of a 2Mbit/s link via the French satellite, Telecom 1. The BTI service is due to be expanded later, when a link to the Netherlands will be opened.

The service is available to users in the UK who have their own videoconferencing facilities or through BT's public conferencing rooms.

Internepcon/Semiconductor Korea '87

The Pacific Basin spotlight will focus on the universe of highly specialized electronics when Internepcon/Semiconductor '87 convenes on 26-28 March 1987 in Seoul, South Korea. Home base for the three-day exhibition/conference is once again the Korea Exhibition Center (KOEX). The trade show is sponsored by the Electronic Industries Association of Korea (EIAK).

More than 350 exhibitors are expected, compared with 327 at the first show in 1985. Exhibitors are comprised of suppliers, agents, and representatives participating either directly or indirectly through local business connections. Three national pavilions will focus exhibits from the United States, United Kingdom and Japan. At the last show, booths were occupied by participants from 14 countries, representing 50 per cent of the exhibitor base.

The emphasis on electronics is paramount in South Korea today. Figures like the almost $1 billion invested in producing advanced semiconductors by Samsung, Hyundai and Lucky/Goldstar since 1983 tend to support that statement. While Samsung and Hyundai have focused on the memory market, Lucky/Goldstar has forged ahead into custom devices. Although the three are sustaining large losses, their track record indicates a serious commitment toward achieving a major niche in the semiconductor market. That niche is twofold: the development of fabs to enable them to compete in world-wide trade, and to serve the needs of their domestic market.

Meanwhile the Korean Development Institute, a government research agency, recently issued some optimistic economic projections which signify the likelihood of a well-attended event. GNP for 1986 is expected to rise to 9.5 per cent. (Earlier government estimates were as low as 7 per cent). The agency also predicted an 18.1 per cent increase in exports for 1986.

More specifics about the exhibition may be obtained from either CEG in the United States or

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* Proceedings available from IASSA, A-2361 Laxenburg, Austria (WP-86-61). Price US$ 7.00.

** See also Microelectronics Monitor No. 18.

Eastern Star Co. Ltd. in Korea. Contact Peter Taylor, CEG, 7315 Wisconsin Ave., P.O. Box 70007, Washington, DC 20088, (301) 657-3090; or Hyuck Moon, Eastern Star, Rm. 1202, Dae-O Bldg. 26-5, Yeoeuido-Dong, Youngdeungpo-ku, Seoul, Korea. Telephone 784-9207. (Reprinted with permission from Semiconductor International Magazine, January 1987, Copyright 1987 by Cahners Publishing Co., Des Plaines, Il. USA)

JIMTOF, Osaka

A machine tool exhibition is as much a reflection of existing demand as it is a suggestion by the machine tool builders of potential demand. So it is fair to say that the Japanese International Machine Tool Show of 1984 got it all terribly wrong. Two years ago, the Tokyo exhibition complex was littered with automatic guided vehicles, flexible manufacturing systems and robots. But in contrast, most of the 5,400 stands at this year's 13th JIMTOF (Japanese International Machine Tool Show) concentrated on stand-alone machines, and the notable developments were:

- Higher rapid traverse rates for machining centres (x and y axes of 24 m/min and z axis of 18 m/min) and lathes (z axis of 24 m/min, x axis of 16 m/min);
- Higher spindle speeds on machining centres (max 20,000) through the use of ceramic bearing materials;
- Increased accuracy and repeatability for machining centres; positional of ± 0.005 mm and repeatability of ± 0.002 mm guaranteed with pulse encoders, and positional of ± 0.002 mm and repeatability of ± 0.001 mm with linear scales;
- The use of linked lathes (typically two) for the production of volume work;
- The use of mechanical handling devices (not usually CNC robots) for CNC lathes - especially gang-tooled types (which were numerous);
- The use of automatic bar loaders;
- Automatic toolchanging (complete tool/toolholder) on lathes;
- Vertical CNC lathes used in automatic transfer lines for volume manufacture, employing a variety of relatively simple parts handling methods;
- Increasing emphasis on machine tool supplier-specific computer software, running on standard hardware, to exploit a machine tool or systems capability: CAD/CAM, computer-aided programming, quality assurance trend analysis, DNC equipment;
- The appearance of the true turning/machining centre hybrid that offers high rigidity for processing basically shaft work with a high content of milling;
- Introduction of machining centres with a grinding capability for machining ceramic components;
- Machining centres with spindle cooling/lubrication to limit machine "growth". In fact, much emphasis was placed on minimizing thermal movement;
- The increasing trend for economic use of floorspace: machining centres with multi-level pallet storage systems, for example.

It should be noted, however, that Japan's domestic industries are automotive, video equipment, camera, watch and electronics - and it is these volume markets that determine much of the content at any Japanese exhibition. (Machinery and Production Engineering, 3/17 December 1986)

IRPTC database free to developing countries

The International Register of Potentially Toxic Chemicals (IRPTC) database is available free of charge to MINISIS users in developing countries. Currently the database holds information on about 600 chemicals, organized by topics such as environmental effects, waste management, and toxicology. The IRPTC was established in 1976 by the UN Environment Programme.

The database will be distributed on magnetic tape, for use with MINISIS storage and retrieval software. MINISIS was developed by Canada's International Development Research Centre (IDRC). Health and Welfare, Canada, which is the IRPTC national correspondent in Ottawa, assisted IRPTC in developing the software necessary to convert the IRPTC database for use with MINISIS.

For further information, or for a copy of the database, please contact: IRPTC, Palais des Nations, CH-1211 Geneva 10, Switzerland. (For more information on the IRPTC, please see the ACCIS Newsletter for January 1985). (ACCIS Newsletter 4, January 1987, p.3)

New body to aid in development of communications

The Centre for Telecommunications Development within the International Telecommunication Union (ITU) is expected to become operational soon. Established by the Administrative Council of the ITU in July 1985, the Centre is mandated to strengthen and expand the scope of advisory services and technical support to developing countries to help remedy, through innovative effort, the imbalance in telecommunications distribution in the world.

To achieve this purpose the Centre will: collect information on telecommunications policies and experience worldwide, and disseminate it to developing countries to help them formulate policies for evolution of their own networks; offer administrative and financial advice on telecommunications development; and provide specific assistance in such areas as preparation of project plans and specifications, manpower planning and training, management, and research and development.

The Centre will be based in Geneva. For more information, please contact: Centre for Telecommunication Development, ITU, Palais des Nations, CH-1211 Geneva 20, Switzerland. (ACCIS Newsletter 4, January 1987, p.3)

Robots application in small and medium industries

With a view to examining a whole spectrum of robotization for making it an effective and efficient tool for higher industrial productivity in APO* member countries, a six-day study meeting was organized on the Application of Robots in Small and Medium Industries in Tokyo from 8 to 13 December last year 1986.

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* APO - Asian Productivity Organization.

The meeting, based largely on the Japanese and newly industrializing countries' (NICs) experiences, was held in collaboration with the Japan Productivity Center, the Japan Industrial Robots Association and other relevant bodies and agencies and it was participated by 14 representatives from 12 member countries, nine resource persons from the Republic of China, France, Japan, Republic of Korea, and Singapore, and two observers from the ILO and France.

Industrial robots have been almost exclusively used in developed countries, notably Japan, USA, Sweden and Federal Republic of Germany. Recently, however, NICs have started to introduce industrial robots in manufacturing operations. Active use of robots is observed in the Republic of China, the Republic of Korea and Singapore among APO member countries. However, mere installation of robots would not automatically lead to an increase in productivity. Robot application requires drastic changes in the entire gamut of the production system. Unless users acquire absorptive capabilities and more importantly, R&D capabilities to make a man-robot-machine system operative, the investment in robots will go down the drain. Furthermore, care should be exercised to measure undesirable effects of robots upon employment. This is an important consideration particularly in developing countries where factor intensity is biased in favour of labour. An impressionistic view is that robotization is not likely to increase employment, if not radically reducing the current level of employment. However, even if developing countries decide to opt out of robotization, the problem is still left due to its indirect impacts. For instance, they cannot stop the investment backflow from developing host countries to developed home countries because robots can undertake labour-intensive operations more quickly, more precisely and more economically. The study meeting was organized with this background.

Recommendations:

Arising from the discussions, the study meeting identified the following measures for adoption at the national and APO levels to promote automation and industrial robotization.

Measures at national level

(i) Governments of member countries can greatly help in accelerating the use of automation and industrial robots through the provision of financial incentives and technical assistance.

(ii) Governments of member countries should re-examine the restructuring of the educational system to prepare the potential workforce to better meet the need of integrated disciplines, such as mechatronics related to the use of automation and industrial robots.

(iii) Governments of member countries should encourage professional bodies to play a more active role in promoting and disseminating know-how of automation and industrial robots, through the organization of seminars, study missions, publications, and the like.

(iv) It has been indentified that one of the hindering factors for small firms adopting automation/industrial robots is the uncertainty or market demand for their products. This may be overcome through the provision of market development assistance and upgrading of marketing expertise by the appropriate government agencies of the member countries.

Measures at APO level

(i) APO should act as a clearing house of information and services.

(ii) APO should depute technical experts to member countries to identify areas suitable for automation and application of industrial robots.

(iii) APO should organize training courses and seminars in member countries to impart knowledge and information relevant to the particular member country. Case studies of situations and environments similar to that country should be used as far as possible.

(iv) APO should organize study missions and exhibitions of industrial robots to increase the awareness level of top and middle management.

(v) APO should develop audio-visual materials to assist member countries to obtain exposure and appreciation of the benefits and problems related to the introduction of automation and industrial robots.

(vi) For member countries, whose state of technology is not yet receptive for the use of industrial robots, APO should put more emphasis on pathing technology such as low cost automation. (APO News, January 1987)

International symposium on education, informatics and the school system

A symposium on the impact of new technologies on the education of tomorrow and, more particularly, the survival of the existing school system is being jointly organized for the beginning of April 1987 by the Fundación Aula and the Instituto de Humanidades of Barcelona. Particular attention will be paid to informatics as an example not only of all new technologies, but especially of those in which information is a key factor. The symposium will go beyond the topics usually discussed at meetings on informatics and education and take up problems in the field of research in education.

Thus, the focus will not be on how to integrate informatics into curriculums or in established teaching methods. Because of the importance of emerging trends for society, and thus for education, the school system cannot afford to remain on the sidelines, nor merely adjust passively as changes occur. A school system must not lose vitality and become worthless with the passage of time, but must grow in keeping with its enormous social function. The 30 international experts at the symposium will be planning for the future by examining what can be done now and the effect that any initiatives might have.

For this reason, in addition to educators, psychologists, experts in informatics, sociologists, scientists, researchers in artificial intelligence, and philosophers will take part in the symposium.

The symposium will be sponsored by the local and regional governments and will have the support of universities, business groups and the cultural representatives from various embassies. (Bulletin IBIPRESS No. 118, 1 March 1987)

International Symposium on IT on Management and Human Resources

The Human Resources Institute at Thammasat University, Bangkok is organizing the above symposium on [illegible] March - 5 April 1987 at the Sheraton Hotel, Bangkok. The conference will fouce on such areas as impact of IT on national development in specific sectors such as industries, services, agriculture and education; impact on law and social aspects, women, management systems, employment and skills, and application in hotel and tourism industry, airlines and banking. (For information contact Dr. Chira Hongladarom, Vice Rector of the Human Resources Institute, Thammasat University, Prachen Rd., Bangkok 10200.)

New informatics undergraduate programme

A bachelor's degree programme in informatics has been instituted by the Federal University of Vicosa, Minas Gerais, Brazil. The curriculum includes coursework in both general studies and professional disciplines, and a concentration in computer science or operations research. Because of the university's reputation in agricultural sciences, it is anticipated that graduates of the programme will be well prepared for work in agricultural informatics. International students from Central and South America and several African countries attend the university. Instruction is in Portuguese. The university year begins in January.

For more information, please contact: Universidada Federal de Vicosa, Conselho de Graduacad, Av. P.H. Rolfs s/no., 36.570 Vicosa, Minas Gerais, Brazil. (ACCIS Newsletter 4(5) January 1987, page 2)

SEARCC and the Singapore Computer Society

The South East Asia Regional Computer Confederation (SEARCC) was host to the meeting of the IFIP Council on 10-12 March 1987 in Singapore. SEARCC came into existence in 1976, and its present membership comprises nine national computer societies: Hong Kong, India, Indonesia, Malaysia, Pakistan, Philippines, Singapore, Sri Lanka, and Thailand. The total membership of all SEARCC national societies comes to over 15,500. SEARCC became a regional Full Member of IFIP in 1982. Mr. Robert Iau of Singapore, who has been the Secretary-General of SEARCC since its inception, is its representative to the IFIP General Assembly.

SEARCC has held biennial regional conferences since 1976. Beginning in 1989, SEARCC will move into an annual conference cycle, and locations for these conferences have been determined up to 1996. In August, SEARCC will host the Second Pan Pacific Conference in Singapore, in conjunction with Singapore's own national conference. Thereafter, SEARCC will include the Pan Pacific Conference as part of its regional conference when possible. Each national society in SEARCC also holds an annual conference or seminar.

SEARCC has established a number of SEARCC Technical Committees to facilitate the regional co-ordination of activities and provide liaison with IFIP Technical Committees and Working Groups. SEARCC has also appointed as Assistant Secretary-General to assist in the co-ordination of rapidly increasing regional activities and to promote regionalism among information processing professionals. A regional professional journal is being planned to appear in 1987. Extensive bilateral contacts have also been established between individual members and the Australian Computer Society, for the purpose of holding examinations to maintain professional standards.

The Singapore Computer Society (SCS) was founded in 1966. Today it has a membership of over 2,000, which includes professionals from Singapore's computer industry, as well as from its academic and research institutions.

The SCS holds an annual national conference and has a rich programme of technical activities throughout the year. It has established its own electronic bulletin board for the convenience of its members. It has been affiliated with the National Computer Board (NCB) since 1983. (The NCB was established by the Government of Singapore to establish plans for developing information technology as a significant industry in Singapore by the 1990s.) Representatives of the SCS participated in the establishment of the NCB and actively serve on the Board and its committees, especially for the establishment of professional standards and public examinations.

Members of the Society also serve on various government bodies as part of SCS's active community service programme. They have made contributions, not only to the NCB, but also to the National University of Singapore, the Economic Development Board, and many other public agencies. (IFIP Newsletter, 1 March 1987)

Calendar of events*

January

21-24 January. Internepcon Japan, Tokyo. Tel. (UK) 01-940 3777, Cahners International.

February

10-12 February. Microprocessor Development Show, Wembley. Tel. (UK) 01-242 3641, Project Presentations.

10-12 February. Optical Memory Technology and Applications, Tara Hotel, London. Tel. UK 01-420 86848, Roy Selwyn.

10-14 February. Communications, Indonesia, Jakarta. Tel. (UK) 01-486 1951, Overseas Exhibition Services.

12-13 February. Conference on the Convergence of Computing and Telecommunications in Practice, Royal Lancaster Hotel, London. Tel. (UK) 01-236 4080, IBC Technical Services.

23-27 February. Fiarex '87 - International Electronics Fair, Amsterdam. Telex 16017, Amsterdam RAI.

March

4 March. The role of MAP and TOPS in integrated manufacturing, Barbican Centre, London. Tel. UK 01-868 4466, Online.

10-12 March. Semicon Europe, Zurich. Tel. (UK) 01-353 8807, SEMI Secretariat.

10-12 March. Communications, Olympia. Tel. (UK) 021 705 6707, ITF.

10-13 March. Electronics and Automation Exhibition and Conference, Oslo. Telex 78748, Messe.

15-21 March. International Switching Symposium, Phoenix, Arizona. Tel. 0603 630440, S.R. Loome.

24-26 March. CADCAM International Show, NEC Birmingham. Tel. (UK) 01-608 1161, EMAP International Exhibitions.

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* Some dates may be subject to change. Readers should confirm arrangements with the organizers.

24-27 March. Info '87 - IT And Office Automation Exhibition, Olympia. Tel. (UK) 01-647 1001, BED Exhibitions.

26-28 March. Internepcon Korea, Seoul. Tel. (UK) 01-940 3777, Cahners International.

April

1-8 April. Hanover Fair. Tel. (UK) 01-651 2191, Deutsche Messe-und Austellungs.

7-13 April. International Telecommunications/Defence Electronics Exhibition, Peking. Tel. (UK) 01-439 4452, China Promotions.

24-30 April. Semiconductor International China, Shanghai. Tel. UK 01-940 3777, Cahners International.

28-30 April. British Electronics Week '87, Olympia, London. Incorporates All Electronics/ECIF Show; Circuit Technology; Electronic Product Design; Electronic Subcontract; Fibre Optics; Power Sources and Supplies; and Automatic Test Equipment. For Automatic Test Equipment - Tel. (UK) 0280 815226, Network Events. For all others - Tel. (UK) 0799 26699, Evan Steadman Services.

May

5-6 May. Canadian High Technology Show, Ottawa. Tel. 0101 613 731 9850, Show Secretariat.

5-7 May. European Unix Systems Exhibition, Paris. Tel. 0280 815226, Network Events.

11-15 May. International Conference on VLSI and Computers, Hamburg. Tel. 010 49 7031 16 3929, Professor Proebster.

12-15 May. Automan '87 - European Automated Manufacturing Systems Exhibition and Conference, NEC Birmingham. Tel. (UK) 01-891 5051, Cahners.

29 May - 4 June. Telecommunications Exhibition, Peking. Tel. (UK) 01-439 4452, China Promotions.

June

2-4 June. International Expert Systems Conference and Exhibition, Novotel, London. Tel. UK 0865 730275, Learned Information.

2-5 June. Manutech - Advanced Manufacturing Technology Show, Olympia. Tel. (UK) 01-891 3426, Independent Exhibitions.

2-5 June. Printed Circuit World Convention IV, Tokyo. Tel. 02812 4092, Institute of Circuit Technology.

3-5 June. European Microelectronics Conference, Bournemouth. Tel. (UK) 01-743 3106, Concorde Services.

15-18 June. National Computer Conference, Chicago. Tel. 0101 703 620 8955, AFIPS.

16-18 June. Networks '87, European Computer, Communications Conference and Exhibition, Wembley. Tel. UK 01-868 4466, Online.

16-22 June. International Robots, Automation Technology and Instruments Exhibition, Peking. Tel. (UK) 01-236 2399, SHK International Services.

23-25 June. Advanced Manufacturing Systems Show and Conference, Chicago. Tel. (UK) 01-940 3777, Cahners International.

28 June - 1 July. Design Automation Conference, Miami Beach. Tel. 0101 303 530 4333, DAC.

July

24-26 July. Internepcon/Semiconductor Malaysia. Tel. (UK) 01-940 3777, Cahners International.

September

7-10 September. Powertech/Hi-Tech Exhibition, Kuala Lumpur, Malaysia. Tel. 0280 815226, Network Events or Tel. 0799 26699, Evan Steadman Communications.

15-18 September. Electronics in Engineering Design - The Interface. Exhibition and Conference, NEC Birmingham. Tel. (UK) 01-891 5051, Cahners.

29 September - 1 October. Semiconductor International, NEC Birmingham. Tel. (UK) 01-891 5051, Cahners.

October

16-21 October. Korea Electronics Show, Seoul. Tel. (UK) 01-439 0501, Korea Trade Shows.

19-23 October. Systems '87 - International Computer/Communications Fair, Munich. Tel. (UK) 01-486 1951, Overseas Trade Exhibitions.

November

4-6 November. Semicon Korea, Seoul. Tel. (UK) 01-439 0501, Korean Trade Centre.

10-14 November. Productronica, Munich. Tel. (UK) 01-486 1951, Overseas Trade Exhibitions.

15-19 November. International Electricity and Electronics Exhibition, Jeddah. Tel. (UK) 021 705 6707, ITF International Agencies.

16-20 November. Paris Components Show. Tel. (UK) 01-439 3964, French Trade Exhibitions.

December

9-11 December. Frontiers in Computing, International Conference, Amsterdam. Tel. 010-31 20 5862 911, North Holland Publishing Co. (Electronics Weekly, 7 January 1987)

NEW DEVELOPMENTS

Japan pursues optical chips

Japan has embarked on a 10-year project to develop integrated circuits that incorporate lasers, light sensors, and transistors all on the same chip. The goal of the 10-billion-yen ($65 million) programme is to make an optoelectronic IC (OEIC) containing 20-30 lasers, each capable of switching on and off 10 billion times a second, according to Tatsutoku Honda, a director of the government-backed Optoelectronic Industry and Technology Development Association.

Such chips could serve in proposed optical computers capable of working 1,000 times faster than today's electronic ones. Closer at hand - probably within five years, says Honda - is a single-chip repeater for long-distance fibre optic links. A detector on one side of the OEIC could convert light signals from an input fibre into electrical form; after amplification by a transistor on the chip, the resulting current would modulate a laser connected to the chip's output fibre, allowing the optical signals to continue on their journey with renewed intensity. OEICs could also enable graphic data to be transmitted all at once instead of being converted into a bit stream; a laser array on one chip would light up to display an image that would then be read by a sensor array on the receiving chip.

The project, spearheaded by the newly-formed Optoelectronic Technology Research Corp., faces major challenges. Making a high-density OEIC, for example, will mean shrinking diode lasers from their present length of 300 microns to about 1 micron. And while electronic circuits run in silicon, most optical devices are based on gallium arsenide or indium phosphide, which require different fabrication techniques. The Japanese are focusing on technologies (such as metal-organic chemical vapour deposition) that can marry these dissimilar materials. (High Technology, January 1987, p. 8)

GaAs OPTO IC gets up to 200 gates

Honeywell Inc. has moved optoelectronic computing a step closer to the product stage by demonstrating a gallium arsenide receiver. The circuit integrates a photodetector, preamplifier circuitry, and a digital 1:4 demultiplexer, all on the same 2-by-2-mm device. The chip decodes a 1-Gb/s optical input into four parallel 250-Mb/s electrical outputs. The circuit carries about 200 gates and exhibits "a density-speed product about 10 times better than any other (optoelectronic) circuit known to date," Honeywell says.

Developed under funding from the Defense Department's Strategic Defense Initiative, the chip is part of a larger DOD effort to push technology for building full-blown monolithic optical transceiver circuits. The idea is to make devices to facilitate direct chip-to-chip communication over high-speed optical fibres. The DOD sees the technique as a way to break the input/output bottleneck that could slow down future systems built with complex, high-speed, I/O-intensive integrated circuits. As part of the push, the Defense Advanced Research Projects Agency has been funding work on optoelectronic interconnection since 1981 at Honeywell and since 1984 at the Rockwell Sciences Center of Rockwell International Corp., in Thousand Oaks, California.

The 200-gate Honeywell device breaks new ground in optoelectronic circuit density, says Sankar Ray, a principal research scientist at Honeywell's Physical Sciences Center here. The digital circuits on Honeywell's chip are built with 1-μm ion-implanted metal-semiconductor FET technology.

Rockwell's optoelectronics manager Kevin Kilcoyne says his firm expects to demonstrate a similar GaAs receiver chip in about a month. It will push complexity even further, by integrating an 1:8 demultiplexer - about 250 gates.

The receiver technology is only part of the problem. The tougher task is the integration of a laser diode on chip with digital multiplexing circuitry to handle the transmission end of the optical link. Under the DOD programme, Honeywell and Rockwell are charged with eventually putting both the photodetector and the laser diode on the same chip. The goal, says John Neff, a programme manager in Darpa's defense sciences office, is to get working monolithic GaAs transceiver circuits by late 1988, integrating the laser and the photodetector with their associated multiplexing circuitry. As an interim step, both firms plan to build a monolithic transmit-only chip.

For its part, Honeywell is working with a transverse-junction-strip laser technology. The firm has fabricated a discrete gallium-aluminium-arsenide laser diode on a 3-inch wafer that operates down to a threshold of 32-mA. By contrast Rockwell is pursuing a multiple-quantum-well laser approach that Darpa's Neff believes holds more potential for reaching the 5-to-10-mA minimum threshold levels that the agency ultimately desires. Rockwell has already demonstrated 22-mA thresholds with its technology.

After a mask modification, Rockwell expects to demonstrate within six months a transmitter chip integrating 8:1 multiplexing circuitry. Honeywell will leapfrog to a 16:1 multiplexer on its first transmitter chip. What is more, the firm plans to build the transmitter device with enhancement/depletion-mode GaAs technology, which the DOD wants for the final transceivers in late 1988. Although built with a more difficult process, the enhancement/depletion- mode parts will save power.

Honeywell expects to have its transmitter with a 16:1 multiplexer ready in about 12 to 18 months. For the transceiver chip, the firm will integrate 16:1/1:16 multiplexer/demultiplexer circuitry. Rockwell is planning to integrate 8:1/1:8 circuitry on its first transceiver. (Electronics, 13 November 1986, p. 31)

AT&T builds first photonic switching chip

AT&T builds first photonic switching chip, a device that may become the primary building block of an experimental optical computer or switching machine. The chip contains four photonic switches, or "transistors", built from 2,500 ultrathin, alternating layers of gallium arsenide and aluminium gallium arsenide. The switches, called self electro-optic effect devices (SEEDs), are turned on and off by light beams, much in the way that electronic transistors are turned on and off by electrical charges.

"The key is that these are cascadable switches," said David Miller of Bell Laboratories and the chip's designer. "The output of one switch can become the input of another because it has sufficient power and the correct wavelength to trip the next switch. That makes this chip a practical device for a parallel optical computer or switching machine."

The switches are positioned two by two in an array to demonstrate the chip's potential use in parallel optical computer architectures. Large parallel architectures allow many bits to be processed simultaneously instead of one by one as in conventional computers. Parallel processing, therefore, can be much faster than serial operations.

Although the on-off action in SEEDs is controlled by light, the chip uses a continuous electrical field to prime the material for switching. The photonic switches consume about as much energy as similar-sized electronic switches, overcoming the problem of high energy consumption, or heat dissipation, that has impeded the development of optical switches. With low energy switches many devices can be packed into a small volume to allow high-speed switching or computing.

"The real advantage of such chips is that optical computing allows massively parallel communication to a degree that cannot be achieved in electronics," Miller said. "And that means enormous potential computing power." For example, if SEEDs 10 micrometers square, or about 0.0004 inches square, covered a centimeter-square chip and were operated at the theoretical limit, such a chip could handle the information equivalent of a phone call between every person on earth simultaneously. The switches on the experimental chip were made 200 micrometers square or about 0.008 inches square.

Bell Laboratories is actively engaged in optical computer and switching research, and SEEDs may be used for the photonic "transistors" in prototype optical machines. Contact: Wes Dvorak, AT&T Bell Laboratories, 201-564-4098. (Information Hotline, November 1986)

Ion implanter brings new life to silicon

A new machine that forms a layer of amorphous silicon dioxide just below the surface of a crystalline silicon wafer will cheer chip manufacturers. Many electronic firms would prefer not to adopt materials more difficult to work than silicon to make better circuits. This machine will help them to stay with silicon. The insulating layers that it makes give silicon chips qualities, such as resistance to cosmic radiation, usually displayed by more exotic materials.

VG Semicon, of West Sussex, built the oxygen ion implanter, named Oxis 100. The machine can treat up to 2,000 silicon wafers a week, enough to fabricate 400,000 chips.

Harwell Laboratory advised on ion implantation (it invented the technology in the 1960s). British Telecom, GEC, Plessey, the Alvey Directorate and the University of Surrey helped with design work and contributed £450,000. VG Semicon put in another £1.35 million, and the Department of Trade and Industry, which funds Harwell and the Culham Laboratory, monitored progress.

The Culham Laboratory designed the source of oxygen ions and the accelerator that fires them at the wafers. The accelerator raises the energy of the ions up to 200 kilo electron volts, and creates an ion current of at least 100 milliamps.

An array of slots splits the ion beam into seven "beamlets". These beamlets overlap slightly by the end of their four-metre journey and cover the wafers evenly.

After the slots, the beamlets enter a toroidal magnet. Only oxygen ions pass directly through the magnet because it deflects atoms, ions and molecular debris by different amounts.

The beamlets then enter a vacuum chamber where wafers, up to 200 millimetres in diameter, sit in a frame shaped like a cone with its top cut off. Halogen lights heat the wafers up to 750° C which helps to keep their surface crystalline.

The frame spins at 120 revolutions per minute. It is angled so that the wafers inside strike the ion beamlets at about 1° to 15°. This makes ions less likely to pass through the spaces between the silicon atoms. The depth at which the oxygen ions are most likely to combine with a silicon atom depends on the energy of the beam. At 200 kilo electron volts, amorphous silicon forms at an average depth of 0.8 micrometres. The layer's thickness, typically 0.4 micrometres. depends on how long the wafer spends in the implanter.

A robot loads and unloads the implanter. The operator inserts or removes cassettes of silicon wafers through a door in a clean room. The implanter is sealed off from the operator.

The amorphous layer in the wafer is an electrical insulator. The barrier helps to prevent radiation generating electrons in a chip and upsetting its circuits. The insulator means that transistors can fit closer together without currents from one interfering with another. And the barrier makes it possible to put logic and power devices together. These so-called "smart power" circuits are in great demand for control systems, telecommunications and defence equipment.

An Oxis 100 costs about £2 million to buy and up to £1 million to install. (This first appeared in New Scientist, London, 6 November 1986, p. 33, the weekly review of science and technology)

Biological memories and processors

A research team at the USA's Carnegie-Mellon University is developing two biological components, a memory and a processor. The first uses a molecule of a compound, bacteriorhodopsine, with two distinct energy levels. The second is based on obtaining a logical circuit starting from two complexes, cyanine and quinone, which combine between them to produce a porphyrin molecule.

The memory is read by a laser capable of reacting to the different form of each of the memory's states of excitation. Depending on the density of the present prototypes, it could store one gigabyte (1,000 million characters) per square centimetre, but theoretically it could attain 100,000 gigabytes. This storage capacity must be contrasted with present research efforts being undertaken by various semiconductor companies to produce a 16 megabyte memory. The biological memory will be able to change from one state to the other in ten picoseconds. These speeds result in the laser ray being where research encounters the greatest difficulties. By way of comparison it may be said that present switching speeds are in the order of 20 nanoseconds and that one nanosecond is 1,000 picoseconds, there being one thousand million nanoseconds in one second.

The processor is operated by two laser rays which produce changes of state and a third by which to detect them. In this case the change takes place in three picoseconds, which is a hundred times less than in an equivalent silicon gate. (Bulletin IBIPRESS No. 108, 23 November 1986)

The secret seven

At the moment, electronics researchers prefer not to think about what happens on the surfaces of silicon crystals. They will soon have to. The atoms inside a millimetre-sized crystal outnumber those on the surface by about a billion to one. But as circuits get smaller, surfaces become more important - and chips' properties will eventually be dominated by their surfaces.

To see why, consider a deflating balloon. As it gets smaller, it has a larger surface-to-volume ratio: the volume decreases with the cube of the radius, but the surface area falls off more slowly with the square of the radius. The same is true of the circuits on a chip as they shrink out of sight. Despite the R&D money lavished on silicon chips, seemingly easy questions about the surfaces of silicon crystals stumped researchers.

A crystal is made of an orderly stack of building blocks called unit cells. The simplest silicon unit cell contains only two atoms. Of the many ways to cut a silicon crystal, the one that most interests surface scientists is done by cleaving it apart. The resulting surface is cleaned by heating it to about 1,000° C in a vacuum chamber (in air, it would oxidize). This rearranges the atoms on the surface to form a giant unit cell containing not two but about 100 atoms - so the new unit cell is dubbed the silicon 7x7 reconstruction, because it is 49 times larger than the usual unit cell.

That much was clear more than 25 years ago. Yet the detailed atomic structure of the 7x7 unit cell has eluded scientists until now. The search for an answer culminated in the award of the 1986 Nobel prize in physics to Dr. Gerd Binnig and Dr. Heinrich Rohrer of the IBM Research Laboratory in Zurich, inventors of the scanning tunnelling electron microscope. Much simpler in principle than the traditional electron microscope, the scanning tunnelling microscope is a fine tungsten needle that is drawn across the surface, displaying the atomic topology in much the same way as a record-player stylus picks up the modulation of the grooves of a record.

The first pictures of the silicon 7x7 surface dramatically confirmed a model proposed by Dr. Kunio Takayanagi of the Tokyo Institute of Technology. The model requires extra silicon atoms, called adatoms, to stick to the surface at specific sites, making the surface chemically more stable. In pictures through the scanning tunnelling microscope, these adatoms showed up clearly. They surprised researchers, who have always had to look at surface structure in indirect, error-prone ways.

Once the adatoms were spotted, the last pieces of the silicon 7x7 puzzle fell into place. More adatoms can be fitted on to the surface by introducing stacking faults - regions where the stacking of the surface-layer atoms is out of step with the underlying crystal structure. But too many stacking faults make the surface unstable. To the theorists' delight, it turns out that the crystal is most stable electronically when the stacking-fault regions criss-cross the surface in a 7x7 pattern.

Dr. Ian Robinson, a British researcher working at AT&T's Bell Laboratories in New Jersey, came up with results that support the same model, using a technique called surface X-ray diffraction. Since X-rays penetrate deep into the crystal, they might not seem the ideal tool for studying surfaces. But this handicap can be used to advantage to study "interfaces" - the structures at the joins between materials.

Metal-oxide-silicon (MOS) chips use an interface between a silicon crystal and silicon oxide. Dr. Robinson's team has confirmed that even if a thick oxide layer is deposited on silicon the 7x7 structure is preserved. This contrasts with many other surfaces, which are violently disrupted by an oxide layer, with damaging consequences for the electronic properties of the interface. All handy stuff to know, in a chip generation or two. (The Economist, 31 January 1987)

Silicon compiler cuts design time

General Electric researchers have developed an advanced chip design tool, known as a silicon compiler, that is drastically reducing the time it takes to develop custom integrated circuits for the company's products. The first two working chips to result from the computerized tool completed the design cycle in just three working days. The design of these chips, containing 35,000 transistors in one case and 15,000 in the other, otherwise would have taken six months or more. (General Electric News Release)

Record pulsed magnetic field

A pulsed magnetic field substantially stronger than ever before recorded has been achieved by Simon Foner, chief scientist at MIT's Francis Bitter National Magnet Laboratory, using newly-developed ultra-fine-structure materials.

Peter A. Wolff, director of the laboratory, calls the work "a breakthrough". Pulsed magnetic fields are the only ones strong enough to enable research on improving important classes of semiconducting and superconducting materials. Fields produced by direct-current magnets are simply too weak.

Foner's record is a pulsed field of 68 tesla, which is more than 1 million times the Earth's magnetic field. This strength was maintained for 5.6 thousandths of a second. (The tesla is an international unit of magnetic flux density; one tesla is equal to about 20,000 times the Earth's magnetic field.) To achieve the record pulsed field, Foner used a magnet wound with a microcomposite copper-niobium wire composed of millions of submicron copper filaments (less than one millionth of an inch in cross-section) separated by and bonded to submicron niobium filaments.

Foner is optimistic about the future uses of such microcomposite materials. He believes that, as the manufacturing technology is perfected, microcomposites will change the course of high-magnetic-field technology.

Foner's research programme is funded by the National Science Foundation, and the new microcomposite wire was developed by Supercon, Inc., of Shrewsbury, Mass. (Technology Review, MIT, February/March 1987, p. 80)

Electron-beam chipmakers move out of the lab

American semiconductor companies are starting to plunk down megabucks for commercial equipment that can turn out so-called submicron chips. These integrated circuits have such infinitesimal lines - much thinner than 1 micron, which is about one-hundredth the size of a human hair - that they could not be made outside the laboratory until now. In late September, Motorola Inc. will take delivery of the first commercial electron-beam system, made by Perkin-Elmer Corp. At least four other US companies, plus a European start-up, have also ordered the $3 million machine, which can produce circuit lines down to an ultratiny 1/4 micron.

Motorola wants the E-beam system mainly for half-micron, very-high-speed chips for the Defense Department. But it will continue to work on other submicron methods because the output of E-beams may be too low for commercial applications. While an E-beam machine traces circuits one line at a time, techniques such as X-ray lithography would photographically "print" images covering entire sections of a silicon wafer. Perkin-Elmer, however, claims that the E-beam approach can boost the yield of good chips. In addition, the system can easily make different chips on the same wafer - the reason European Silicon Structures, in Munich, wants one to turn out custom chips. (Business Week, 29 September 1986, p. 67)

MARKET TRENDS AND COMPANY NEWS

Silicon done your way*

Within the last three years, application-specific integrated circuits (ASICs) have begun forcing radical changes in the way ICs are designed and manufactured, and have even started changing the way chip suppliers do business with their customers. ASICs - integrated circuits whose functions are specified by the user - are often produced by a specialist maker, as opposed to general-purpose ICs, such as memory chips and microprocessors, made by the large merchant semiconductor manufacturers. An ASIC may be as complex as a microprocessor or as simple as a single-chip controller for a coffee maker.

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* Special review article by Jeffrey Bairstow, senior editor of High Technology Magazine.

Today, the system designer has available a vast array of ASIC devices, from simple logic elements that may be programmed on the engineer's desktop to predesigned libraries of complex circuits such as microprocessors and modems that can be assembled automatically on the same chip. Some manufacturers offer a wide variety of ASIC technologies, so an engineer may design and prototype a chip with the simplest and least expensive circuits and then move up to more sophisticated IC techniques for manufacture in volume. And it may soon be possible to check out and prototype a design within 24 hours. In addition, the software tools needed to design ASICs are now widely available for relatively inexpensive workstations and personal computers. Consequently, the ASIC business is booming.

ASIC revenues are expected to reach $5.8 billion this year and to zoom to $13.1 billion by the end of the decade, according to Andrew Prophet, a senior industry analyst with Dataquest (San Jose, Cal.). By contrast, the worldwide semiconductor business as a whole has recently been declining at a 20 per cent annual rate.

The advent of ASICs is bringing IC design capabilities to a broad new constituency. "Last year, semiconductor manufacturers generated fewer than 10,000 new IC designs," says Andrew Rappaport, president of The Technology Research Group (Boston). In essence, about 4,000 IC designers, employed mostly by the merchant semiconductor companies, produced an average of one design each, while some of the more than 200,000 electronic system designers turned out about another 5,000. But while few system designers currently have the IC experience or familiarity with the available automated tools to produce their own ASIC designs, that situation is changing rapidly. In just four years, claims Rappaport, system designers alone will create almost 100,000 new designs per year.

Because the traditional methods of producing ICs simply cannot cope with such a flow, ASIC designers are often turning to "silicon foundries", companies that do little design work but exist to turn out chips devised largely by their customers. Meanwhile, merchant semiconductor makers, faced with the prospect of losing 30 per cent or more of the IC market to entrepreneurial foundries, are not standing idly by; instead they are scrambling to set up their own ASIC design centres, which furnish customers with proprietary computer-based tools to design their own ASICs for manufacture by the IC vendor. Using a display terminal or workstation, the customer can design and check the logic of the circuits, as well as simulate the function and timing of the design.

The growth of the ASIC business is driven by two forces, says Peter Richmond, marketing manager for General Electric's Customs IC Department "the rapid development of silicon-gate CMOS [complementary metal-oxide silicon] technology and the increasing advancement of CAE [computer-aided engineering] tool for IC design". In the first case, he says, the turning point came about five years ago with the development of 5-micron CMOS circuits, which permitted more than 1,000 logic gates on a single chip. ("Five-micron" refers to the average length of a gate, the basic logic element.) Today, notes Richmond, 2-micron technology is cramming more than 10,000 usable gates onto a chip. Several manufacturers will shortly introduce 1.5-micron gate arrays, which will effectively double the possible number of gates. What's more, some memory makers in the US and Japan are already preparing for submicron technology, although that level of integration is not yet required for ASICs.

While semiconductor manufacturing technology is always a step or two ahead of the potential users of ICs, claims Richmond, "CAE tools tend to lag behind the users' needs. We're just beginning to see personal computer-based CAE tools that can comfortably handle the design and simulation of circuits with up to 2,000 gates". The trend in ASIC design is away from expensive, dedicated workstations, such as those made by Daisy Systems and Valid Logic, in favour of PC-based systems, such as those offered by FutureNet and Telesis Systems, and general-purpose engineering workstations.

More sophisticated engineering workstations, such as those made by Apollo Computer and Silicon Graphics, can handle around 5,000 gates easily, says Richmond, whereas 10,000 gate circuits and larger still require the capability of a mainframe computer, typically a Digital Equipment Corp. VAX system. But as PCs add more memory and increase their processing speeds, he says, the size of the IC designs they can handle will increase dramatically.

There are three basic ways of designing integrated circuits, all of them requiring automated tools for entering and simulating the design: gate array, standard cell, and custom. All three methods may be used to design ASICs, depending on the complexity of the circuit and the volume of chips to be manufactured.

The simplest technique, and probably the most frequently used, is the gate array. As the name implies, a gate array is a standard array of logic elements, or gates, diffused into a silicon chip. The connection of the gates is determined by the system designer and accomplished with one or sometimes two layers of metal interconnections deposited on top of the silicon. A typical gate array will contain anywhere from a few hundred to a few thousand gates. However, gate array manufacturers are constantly increasing the density of gates on a chip. Arrays of more than 100,000 gates are now possible, says Rick Rasmussen, product manager for LSI Logic, the leading US manufacturer of gate arrays. Not all the gates on a chip are used: the interconnections would be too complex. Several major Japanese semiconductor makers, notably Fujitsu and Toshiba, have also been successful in making large gate arrays.

The standard cell approach is based on predefined integrated circuit designs, such as buffers, gates, flip-flops, decoders, and multiplexers, each forming a standard building block or cell. From a library of cells, provided by the IC maker, the designer builds a circuit with the desired functions. Design automation tools are used to lay out the standard cells on a chip and route all the interconnections. Since the range of functions available in a standard cell library is extensive, such designs are often more complex than gate array designs. Standard cells also achieve higher circuit density and so make more efficient use of the silicon real estate. Production, however, is more complex - comparable to that of general-purpose ICs.

The leading standard cell vendor is probably NCR Microelectronics, which has a co-development alliance with Motorola that allows customers to switch freely between the two companies' gate array and standard cell options. Other leading standard cell vendors are VLSI Technology, an ASIC vendor with a highly regarded tool library; and Zymos, a company recently purchased by the Korean conglomerate Daewoo.

Chips designed through gate array and standard cell techniques are often referred to as semicustom integrated circuits, since they use predefined elements. Thanks to design automation tools developed by semiconductor makers, silicon foundries, and specialized software houses, neither technique requires much IC design experience. In contrast, full custom circuits are designed from scratch by experienced IC designers to achieve the maximum packing of transistors and other circuit elements on the chip. Because full-custom design and layout is more expensive and time-consuming than semicustom methods, it is used only when extremely high performance is waranted - as in the case of a microprocessor - or when production volumes are expected to be large enough to justify the additional costs. The major companies in the full-custom field are the leading merchant semiconductor makers, notably Intel and National Semiconductor, Texas Instruments, and such Japanese makers as Fujitsu and Toshiba.

For semicustom circuits, whether gate array or standard cell, the design, testing, and manufacturing process is largely the same. There are four phases: a design phase, taking two to ten weeks, either at a vendor's design centre or on the system engineer's own workstation; a layout phase, taking one to four weeks, usually on the semiconductor vendor's mainframe computer; a prototyping phase, taking four to eight weeks, at the vendor's production facility and finally a production phase, taking perhaps 12 to 14 weeks to reach full volume.

In designing a circuit, a system designer using an engineering workstation or a PC-based CAE system begins by selecting the necessary logic elements from the standard cell library offered by the semiconductor vendor, a process called schematic entry. The system designer then uses a logic simulator on the workstation or PC to check that the logic will function correctly. A second simulation program checks for timing problems.

When the designer is satisfied, a network listing (netlist) is generated so that either the vendor's mainframe CAD system or the designer's workstation can automatically place the standard cells on a chip layout and determine the routing of the interconnections. The system checks to ensure that none of the design rules for that particular semiconductor technology have been violated, and performs a timing analysis using the actual timing delays caused by the interconnections produced by the layout program.

Once the layout is verified, the semiconductor maker produces the photolithographic masks needed to etch the silicon, and prototype circuits are built for testing by the system designer. If the prototypes are successful, the vendor can then make the circuit in volume. The Motorola-NCR alliance permits system designers to develop and prototype a design as a gate array and then convert the logic to a standard cell version with the help of computer-aided design tools. Gate arrays can be prototyped faster and at lower cost, while standard cell designs can often be manufactured less expensively a larger production volumes.

Prototyping time can cut even further with a laser-programmable gate array technique developed by Laserpath Corp. Laserpath programmes arrays by cutting away unwanted connections on a premetalized array, a process that takes about three hours for a 1500-gate chip. "Ultimately," says company president Michael Watts, "we expect to achieve one-day turnaround" after receiving the chip layout. The company charges $13,500 for five 1,500-gate prototype chips, abut half the cost of conventional gate arrays.

The laser-cutting technique is available only through an ASIC vendor. But an alternative, the programmable logic device (PLD), can be modified directly by the system designer. One form of PLD is the programmable array logic (PAL) - supplied by Monolithic Memories (Santa Clara, Cal.) - which contains up to 2,000 logic gates. At each intersecting point in the logic array is an electrically programmable connection; depending on the logic design, some of these connections will be opened during programming.

Another form of PLD is an erasable programmable read-only memory (EPROM) with a gate array architecture. Logic design with an EPROM is similar to other semic[illegible]m methods. The designer begins with schematic entry and proceeds through verification and simulation to produce a netlist. Special software provided by the PLD maker converts the netlist into instructions for electrically altering the state of the connections. If the prototype PLD is not satisfactory, the design can be reworked and the EPROM erased by a short exposure to ultraviolet light. The PLD is then ready to be reprogrammed.

At densities of less than 2,000 gates, a PLD can be used as a relatively inexpensive gate array prototype. "It's safe to assume we haven't seen the limits of PLD density," notes Rappaport, and performance and capacity are in fact increasing. Several merchant semiconductor vendors offer EPROM devices, but the most active suppliers in this area are relative newcomers such as Altera, Cypress Semiconductor, and Xilinx. Altera offers a PC-based CAE system for programming its PLDs for as little as $2,500, including an add-on board for the PC, logic design and device programming software, and a sample pair of PLDs. Altera's PLDs can be designed on an engineer's desk-top in a matter of hours, according to David Laws, vice-president of marketing. "Eventually," says Rappaport, "programmable logic will be used for all but the densest designs to identify and correct functional errors. Metal-programmed parts, whether laser-zapped or conventional gate array, will be used for final checkout."

While PLDs leave everything in the hands of the design engineer, Cirrus Logic keeps its cards close to its chest with an unusual standard cell approach to ASICs. "We will sell only the product and not the recipe," says president Michael Hackworth. Cirrus Logic has developed a series of what the company terms "semistandard" ICs for data communications, graphics, and disk drive controllers. The company gives customers concept specifications for, say, a disk drive controller, similar to the engineering data sheets that semiconductor vendors provide for off-the-shelf devices such as microprocessors and memories. Customers can alter the specs to suit their purposes, changing operating frequency or input/output levels, for example. Cirrus Logic takes the revised specs and uses a proprietary specialized silicon compiler to produce a design that is optimized for the particular application. Cirrus Logic takes full responsibility for the design, testing, prototyping, and manufacture of the finished chip. The customer need not be familiar with IC design and is not required to learn how to use unfamiliar CAE tools. "Our customer's design tool is a very user-friendly ball-point pen," says Mark Singer, manager of marketing communications. Similar semistandard ICs are offered by Silicon System.

In part, the Cirrus Logic approach is a response to a major hurdle for novice ASIC designers - the considerable effort needed to become familiar with automated design tools. Many ASIC suppliers have set up design centres where customers can work on the vendor's own computers and receive immediate assistance with problems as the design work progresses. When Don Mills, director of hardware development for PBX maker CXC Corp., decided to develop some standard cell circuits for a new generation of PBX equipment, he decided to do so at one of NCR's design centres. "Everything went pretty smoothly on that first project," he recalls. "But we had a much longer learning curve on the second project when we decided to use our own workstation." Not only did CXC's engineers take longer to learn how to use the schematic entry and simulation software, but the Mentor Graphics workstation, an early model, had limited capacity and was too slow for the 5,000-gate circuits under development, thus further extending the design time.

Recognizing that inexperienced designers often have difficulty learning to use the current generation of tools, some ASIC firms are spending at least as much on software development as on improving their manufacturing processes. "The ASIC vendor who doesn't will not survive," claims Andrew Haines, ASIC marketing manager for VLSI Technology.

In this spirit, several ASIC companies - especially VLSI Technology, Waferscale Integration (Fremont, Cal.), Zymos, and England's Plessey Co. - are attempting to bring sophisticated VLSI designs within the reach of more system engineers by offering larger and more complex cells. These "megacells" are VLSI elements such as a core microprocessor, a peripheral controller, or a complete communications modem predesigned within one large cell. Thus the ASIC designer is spared the effort of designing the logic for, say, a modem, and need only change such specifications, speed and word length to obtain the desired function. A relatively straightforward compiler is used to customize the megacells, resulting in shorter design time and a more efficient use of silicon. Plessey likens its approach to the spreadsheet used in business for financial modelling. In essence, all a designer must do to set the parameters of a megacell is insert numbers into a "silicon spreadsheet".

Zymos has taken the megacell idea even farther with the concept of a "silicon template", a complete computer system design on a chip. The system engineer combines several megacells that have been completely designed, simulated, and laid out, and then stored in a software library. As in the silicon spreadsheet approach, the designer can alter the parameters of the cells making up the system to improve overall performance or customize for a specialized application. Zymos, for example, developed an IBM PC/AT silicon template including most of the components (all except the microprocessor, the dynamic memory, the basic ROM, and the keyboard controller) on a 25,000-gate chip less than half an inch square. In effect, the number of chips in the PC is reduced from 90 to four, claims Robert Andrews, director of technical marketing for Zymos.

The megacell and the silicon template simplify the system design process; the engineer need not know in detail how to design the circuitry of a modem or a drive controller. The next stage in bringing ASIC design to a larger community of designers is probably the wider acceptance of silicon compilation - the automatic synthesis of ICs from a behavioural description of the system, as opposed to conventional design by entry of a logic schematic diagram. Although silicon compilation had been around in the academic world for several years, practical commercial compilers have only just begun to appear. In 1985, approximately 100 workstations with silicon compilation capability were shipped, according to Dataquest, but sales are expected to triple in 1986 and continue to triple through the end of the decade.

The early silicon compilers were expensive and aimed more at the sophisticated IC designer than the system engineer. The first Genesil silicon compiler from Silicon Compilers, Inc., required a large VAX computer and cost more than $100,000 per terminal. Silicon Compilers and other vendors such as VLSI Technology, Seattle Silicon Technology, and Silicon Design Laboratories are now making their compilers available on less expensive engineering work stations. None has gone quite so far as Lattice Logic Ltd. (Edinburgh, Scotland), which recently introduced its Silicon Compiler Spreadsheet, a package that runs on an IBM PC/AT with an added 32-bit coprocessor. The Silicon Compiler Spreadsheet is restricted to circuits containing fewer than 5,000 gates. But since most of today's ASICs fall within that limit, many industry observers expect the spreadsheet concept to proliferate.

While silicon compilers are currently suited only to digital circuit design, the interfaces required between computers and industrial controls or instruments are analog. Thus analog functions are becoming an increasingly important part of many semicustom chips. "By 1990 about half of all semicustom chips will contain some analog circuitry," says Cindy Thames, a vice-president of The Technology Research Group. "Customers will choose libraries and vendors on their ability to do analog." Although demand for analog capability is increasing, the tools for automating the design of analog circuits are not as mature as those for digital IC design. Not only are analog circuits such as operational amplifiers and analog-to-digital convertors more difficult to design as integrated circuits, because of their requirements for linearity and precision, but high-performance analog chips are more sensitive to electrical interference and thermal effects than all-digital chips.

One solution is to use analog standard cells rather than attempting to design at the transistor level. NCR and Gould AMI both offer some analog standard cells. Probably the most extensive library is provided by a relative newcomer, Sierra Semiconductor, which offers over 30 analog cells compatible with a 2-micron production process. Sierra can also combine digital, analog, and EEPROM (electrically erasable programmable ROM) technology on the same chip, says Don MacLennan, Sierra's director of custom product marketing. The EEPROM cells provide replacements for potentiometers, switches, and other means of calibrating and programming system functions, important for analog circuits. Sierra is working with Seattle Silicon Technology to incorporate analog functions into the latter's Concorde silicon compiler, further simplifying the design process for system engineers who wish to combine digital and analog functions.

Most industry observers expect the automated tools required for ASIC design to become easier to use and faster as the ASIC market expands. "Silicon compilation is not yet of age," says Andrew Kessler, an analyst with Painer Webber (New York). "But it's becoming well used for military applications where performance is paramount and efficient use of silicon is a factor. That body of experience will result in improvements in silicon compilers."

The acceptance of silicon compilation may have been slowed by the cost of both hardware and software. But the coming generation of 32-bit personal computers based on the Intel 80386 microprocessor will bring powerful workstations within the reach of many more system engineers. Such machines will be capable of handling the massive computation and large memory requirements of silicon compilers and cell libraries.

Ideally, system designers would like to be able to produce circuits as efficient as the full-custom designs generated by experienced IC designers. "We're not too far away from seeing tools based on artificial intelligence," says Sierra Semiconductor's MacLennan. "Then we'll be able to bring the best IC designer's know-how to the system engineer." Already Gould AMI and the US Army's Electronic Technology and Device Laboratory are working on a silicon compiler that uses a stored base of expert design knowledge. When such knowledge can be captured in every system engineer's workstation, ASIC design could well become the method of choice for electronic systems. (High Technology, November 1986, pp. 38-44. Reprinted with permission, High Technology Magazine, January 1987. © 1986 by High Technology Magazine, 38 Commercial Wharf, Boston, MA 02110, USA)

Semiconductor market 1987

The semiconductor industry will pick up a little more speed in 1987. The Electronics industry survey predicts growth in US demand reaching 12 per cent, with sales reaching $12.4 billion overall. In 1986, the Electronics survey shows, the industry grew only 7 per cent, to $11.1 billion. But both years' gains will not move the industry back to the level of sales seen in 1984, the last boom year.

Integrated circuits should see a 12 per cent gain to $10.4 billion, against last year's 8 per cent rise to $9.3 billion. Discrete semiconductors will rise 10 per cent to $1.6 billion, a marked improvement over last year's 3 per cent gain. And optoelectronic devices will increase 14 per cent overall to $348 million. This sector grew 12 per cent last year, with sales of $304 million. In all market sectors, dollar growth will come mainly from higher-volume consumption of such products as CMOS microprocessors and memories, advanced linear ICs, MOS power transistors, and high-resolution optoelectronic arrays. These chips command higher prices than older commodity products, which have suffered severe price erosion.

Within the far larger IC sector, the Electronics survey shows microprocessors, microcomputers, and related ICs advancing 12 per cent to $1.8 billion, following a 9 per cent increase and $1.6 billion in sales in 1986. Here, growth will be paced by high-performance CMOS devices that command prices of up to $300, compared with $5 or so for older MOS chips. Doing even better are semicustom chips that replace high-cost subsystem assemblies. Standard cells, for instance, are due to rise 47 per cent to $287 million, and electrically programmable gate arrays should go up 50 per cent to $51 million.

In memories, the overall market should grow 12 per cent to $2.2 billion, following a scant 6 per cent rise in 1986. CMOS static memories, which are replacing cheaper types because of their superior speed-power product and large capacities, are forecast to rise at a brisk 19 per cent, to $273 million. Dynamic random-access memories, which grew only 5 per cent last year, should improve to 9 per cent this year, thanks to the higher prices resulting from the recent US-Japan trade agreement. The fastest-growing DRAM naturally is the newest: Electronics shows the 1-Mb chip up almost 200 per cent, to $203 million.

Although most industry watchers agree that 1987 will be better than 1986, there's wide divergence over just how good the recovery will be. On the side of the optimists is Dataquest Inc., the San Jose, Calif., market research house, which sees IC consumption rising 14 per cent, including a 17 per cent rise in microprocessors and microcomputers, and a 12 per cent rise in DRAMs. In contrast, Integrated Circuit Engineering Corp., Scottsdale, Ariz., predicts an up-down cycle in 1987. ICE expects the year to end in a 9 per cent growth rate, but predicts overall US growth of only 4 per cent, compared with 10 per cent worldwide.

In the past three years, original-equipment manufacturers have twice built up inventories to avoid shortages, then cut back on orders while using up the surplus. Now they see little point in refilling their stockrooms, because the semiconductor industry has about twice as much capacity as orders.

On the plus side, the stage is now set for a more orderly US market. Not only was the buying binge in the first half of 1986 smaller and shorter that the one in 1984, but also it produced only a minislump compared with 1985. In December, the Semiconductor Industry Association reported that book-to-bill ratios, which compare orders and shipments, had risen in October and November to 0.99, indicating slow growth combined with inventory depletion.

Indeed, inventory depletion comes up again and again in conversations with industry executives, along with the hope that US computer and peripheral production - the largest single consumer of semiconductors - will catch fire this year. Michael Graff, vice president of marketing for Harris Corp. Semiconductor Sector, believes that IC shipments now closely match actual consumption in assembly plants. The same is true of discrete components and linear ICs, says Peter Jenner, director of new product planning for Unitrode Corp. He argues that sales would rise even with no growth in equipment markets because real consumption has overtaken shipments.

In any event, growth needs to hit 15 per cent in order to offset the abnormal price erosions of the past few years and to restore profitability to the industry.

The big excitement in the IC market is the strong growth projected for several new products, such as the 32-bit microprocessors. The 32-bitters should soar 20 per cent to $83 million, on top of a 25 per cent increase and $69 million in sales last year. Intel Corp. expects its new 80386 32-bit microprocessor alone to have a significant impact on the industry, says Ronald Whittier, vice president and director of marketing of the Santa Clara, Calif., company. "We also see continuing pervasiveness of the 16-bit machines and continuation of all the product lines going into CMOS," he adds.

Indeed, advanced CMOS versions of the older MOS processors are also in the forefront of the microprocessor market. Their growth rate will double from 6 per cent to 12 per cent, producing $263 million in sales in 1987 compared with $234 million in 1986. But bipolar microprocessors will slow from 28 per cent growth to just 10 per cent, realizing $170 million in sales.

Although competition is keener than ever in the semicustom IC arena, growth rates are still high. Electronics forecasts a 20 per cent growth rate overall in the custom and semicustom market. But the semicustom chips, with their shorter turnaround times and lower design costs, are responsible for virtually the entire spurt. Although the custom market will still be huge, at $821 million, the growth rate will flatten from 4 per cent to 2 per cent because of the continuing swing to semicustom chips.

Especially strong are such start-up technologies as electrically programmable arrays, which should grow 50 per cent to $51 million on top of more than 300 per cent growth and $34 million in sales last year. Gate arrays, though, have become commodity products. Also, they're being squeezed out of the low-volume market by programmable arrays and out of the high-volume market by standard-cell circuits, which offer greater flexibility and more functions per chip. Still, with rapidly increasing production volume, this category should post a 26 per cent growth rate to $822 million, on top of 24 per cent to $653 million in 1986.

Standard cells, too, are in for a robust year. This category should catapult 47 per cent to $287 million in 1987, compared with 27 per cent and $195 million last year. This growth largely accounts for the diminishing luster of the traditional, handcrafted custom IC market.

Electrically erasable programmable read-only memories should post a 21 per cent gain, to $80 million, after a 1 per cent dip in 1986. Much of the gain in EEPROMS comes from the increasing use of parts up to the 64-K size in such applications as updating-instrument-and-control settings. To boost sales, producers are coming out with higher-density, flash-technology devices that cost only about one third more than ultraviolet-erasable EPROMS, instead of 5 to 10 times as much.

But EPROMS are still alive and well. Electronics shows this category growing 11 per cent to $387 million, compared with a scant 3 per cent gain, to $349 million, in 1986. One reason: by the end of 1986, US prices for 256-K chips had risen to 10 per cent more than world prices in the wake of antidumping restrictions on Japanese imports. Moreover, customers have trimmed down excessive inventory.

Similarly, dynamic RAM growth of 9 per cent is largely the result of price increases created by the US-Japan trade agreement. However, the foreign market values set in the pact allow Japanese firms to recapture US market share lost during the cut-throat competition of 1985. About 75 per cent of the Japanese manufacturers' US revenues come from DRAMs.

In the linear IC market, Electronics pegs the growth of data converters - the largest single chunk - at 10 per cent, with sales of $496 million. This segment dropped little in 1985 and has grown steadily since then. Moreover, a high proportion of converters are proprietary designs with fairly stable prices. (Reprinted from Electronics, 8 January 1987, pp. 68-69, © 1987, McGraw Hill Inc., all rights reserved)

Semiconductor shipments grow more than 17 per cent worldwide in 1987

Total worldwide solid state shipments are expected to grow to more than $40 billion in 1988 from an estimated $27 billion in 1986. Last year's figure represents a sizeable 25.6 per cent gain over 1985's dollar-based volume, an above-average gain by historical standards. But about two-thirds of that increase was due solely to the recent appreciation of the Japanese yen and the major European currencies against the dollar. If adjustments for exchange rate shifts were made, the gain would be only about 8 per cent, a much less cheery performance. The dollar is expected to be more stable in 1987, so most of this year's projected 17.7 per cent increase will represent true growth. Growth should accelerate to 26.4 per cent in 1988.

US semiconductor shipments to quicken in 1987

The US semiconductor market, which had shown hints of a recovery in early 1986, turned down again toward midyear. Weak capital investment caused most electronic equipment manufacturers to scale back production levels and reduce their component purchases. The dip was brief, however, with orders beginning to climb again by autumn. Semiconductor shipments to the US markets by US, Europe and Japan-based manufacturers are expected to total $8.7 billion for 1986, a gain of more than 7 per cent from the prior year. The US economy will strengthen slightly in 1987, pushing semiconductor shipments up about 20 per cent annually. Next year, a gain of 31.3 per cent is expected, with volume reaching a new record of $13.8 billion.

Japanese semiconductor sales react to stronger yen

Sluggishness in Japan's economic growth has become more pronounced in recent months, due to the lapped effects of the yen's rapid appreciation on foreign exchange markets in 1985-1986. Although export numbers look good when measured in dollars, they are poor when measured in domestic currency. For example, semiconductor shipments to Japanese buyers are projected to show a yearly gain of 41.8 per cent to $10.78 billion in 1986. Changes in the yen-dollar value will be responsible for nearly all of the increase. With exchange rates becoming more stable, dollar-based growth is expected to slow to 15.2 per cent this year and then to rise slightly to 17.5 per cent in 1988.

Small pickup ahead in European semiconductors sales

Growth in most major European industrialized countries in 1987 will be the same as or better than it was in 1986. This modest overall improvement will mean slightly stronger sales of semiconductors in Europe. When final 1986 figures are reported later this month, total European Semiconductor shipments are expected to come in at a yearly total of $5.5 billion, an increase of 21.7 per cent over the level in 1985. If the effects of the dollar's recent depreciation relative to most European currencies were taken into consideration, then the rise would be only a percent or two. A gain of 16.6 per cent is projected for 1987, followed by an 18.2 per cent growth pace next year. (Reprinted with permission from Semiconductor International Magazine, January 1987, pp. 37-38. © 1987 by Cahners Publishing Co., Des Plaines, Il. USA).

Custom chips outpace conventional circuits

The market for application-specific integrated circuits (ASICs) is flourishing, even in the midst of slow growth for semiconductors generally. According to Dataquest, ASICs will expand by 25-30 per cent this year - a growth rate almost three times that of the total IC business - to constitute a worldwide market of $5.8 billion. "ASICs could account for up to half of the total IC market within 10 years," says Wilfred J. Corrigan, president of LSI Logic. "By 1990, ASICs will represent a $12-15 billion market."

The ASIC market is composed of four segments. Over half of it consists of fully customized circuits - extremely compact and capable devices whose high development costs make them most suitable for use in high-volume goods such as watches, calculators, and other consumer products. The market for such ICs, however, will remain essentially flat into the next decade as design-automation tools, such as computer-aided engineering (CAE) workstations and silicon compilers, grow in power and sophistication.

Figure 1

Semiconductor Industry Indicators

	1st Qtr 1986	2nd Qtr 1986	2nd Qtr 1985	1985	1986	1987	1988
Semiconductor shipments (US$ billions)							
Total solid state - worldwide	5.75	6.70	5.42	21.48	26.99	31.76	40.17
- US	1.95	2.21	2.07	8.09	8.72	10.47	13.75
- Japan	2.23	2.63	1.89	7.60	10.78	12.41	14.58
- Europe	1.36	1.36	1.15	4.54	5.52	6.44	7.62
ICs - worldwide	5.13	5.13	4.18	16.49	20.72	24.66	31.60
Discretes - worldwide	1.57	1.57	1.24	5.00	6.27	7.11	8.57
	Sept. 1986	Oct. 1986	Oct. 1985	1985	1986	1987	1988
Book-to-bill ratio - US	0.92	0.98	0.81	0.81	1.01	1.10	1.20
	Aug. 1986	Sept. 1986	Sept. 1985	1985	1986	1987	1988
Semiconductor employment - US 1/	268.6	267.6	273.4	3352	3212	3259	3505
Electronic end equipment production 2/	221.8	223.0	222.2	226.4	222.5	233.4	258.9

Source: Semiconductor International, January 1987.
1/ Thousands of workers
2/ Index, 1977 = 100
Historical data: Semiconductor Industry Association, Bureau of Labour Statistics, Federal Reserve Board.
Forecasts: Cahners Economics.

Thanks to such tools, gate arrays and standard cells - less complex ASICs that make use of some predefined elements - will take over a larger share of the market. The gate array market will rise from $2 billion in 1986 to $5.6 billion by 1990, while standard cells with explode from $250 million at present to almost $4 billion by 1990, according to Dataquest; during the 1990s, the standard cell market should surpass that for gate arrays.

Programmable logic devices, the fourth ASIC segment, are the least complex and easiest to design. At about $230 million, their current market is on a par with that for standard cells, but the growth rate will not be as pronounced; by 1990, this market should be worth $1 billion.

ASIC vendors tend to specialize according to market segment. Full-custom circuits are manufactured by National Semiconductor, Texas Instruments, Intel, and several Japanese firms. The leading producers of gate arrays and standard cells are LSI Logic and NCR Microelectronics, respectively. Standard cells are also offered by Zymos and VLSI Technology. Vendors of programmable logics devices include Monolithic Memories and Altera, and Xilinx.

In addition to the production of ASICs, some companies also provide services that enable customers to design, simulate, prototype, and test the circuits they plan to use. A quarter to a third of the 1985 market for each ASIC segment was composed of such service functions. These costs are likely to decrease as design equipment comes down in price. For example, "today's $100,000 CAE workstation will cost a half to a third as much by the end of the decade," says Andrew Prophet, senior industry analyst at Dataquest, "and by that time $100,000 will put the equivalent of a mainframe computer on the design engineer's desk." He adds that the proliferation of these workstations - produced by such firms as Valid Logic and Daisy Systems - will result in greater familiarity with gate array and standard cell designs.

Silicon compilers, which permit users to synthesize ASICs from a description of the required functions, are also becoming an important design tool. One of the most serious challenges to vendors of such equipment - including Silicon Design Laboratories, Silicon Compilers, and Seattle Silicon Technology - is to provide chip design software sutiable for individuals not trained in semiconductor engineering. As ASIC design becomes more automated, Dataquest expects the number of workstations incorporating silicon compilers to rise from 100 last year to 10,000 by 1990, an installed base worth over $500 million. (High Technology Magazine, November 1986. Reprinted with permission, High Technology Magazine, January 1987, © 1986 by High Technology Magazine, 38 Commercial Wharf, Boston, MA 02110, USA)

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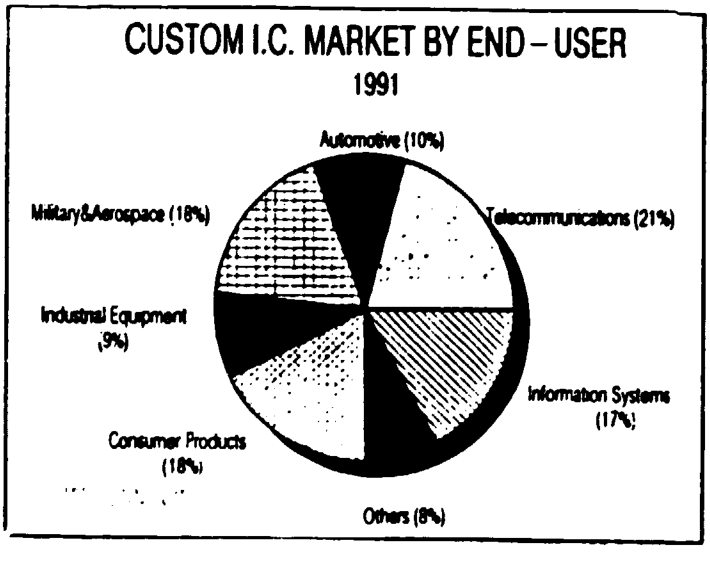

Custom chip in Europe

The production of custom or semicustom integrated circuits tailored to a producer's needs, whether it be for use in a TV, computer, or missile, was once a painstaking process taking months in design and testing. But now, says "Custom Integrated Circuits Market in Europe", a new 271-page report from Frost & Sullivan, "the shortest available time is four weeks from inquiry to supply of working samples." This speed is "probably the most important factor which will accelerate the market", the study says in predicting a sales rise of some 24 per cent a year - which tops the 20 per cent annual pace being posted by ICs in general.

Computer-aided engineering (CAE) and CAD/CAM in the semiconductor industry have cut costs "dramatically", and receive most of the credit for the boom; IC engineers can now verify and debug their designs while still in the database, meeting the new "emphasis on fast, right-first-time product development". In constant 1985 dollars, the report says the market will climb from $818 million in 1985 to $3 billion by 1991. National market, end users, product types, and suppliers are all discussed.

"Of all the European markets the prospects for growth in the Federal Republic of Germany are by far the best," the study says. For example, the average age of industrial plant there was 13 years in 1984 versus 10 years in 1974 - meaning replacement of obsolete plant will aid custom and semi-custom ICs (such as in machine tools). The country accounts for nearly a quarter of the entire market, or nearly 458 million deutsche marks in 1985 (at exchange rates then).

The UK market is nearly as large as the Federal Republic of Germany's (106 million in 1985); roughly 40 per cent of sales there are to information systems and telecommunications end users. The report also shows the military to use a relatively high share of the products, as the UK has been leading in the development of data encryption systems and electronic countermeasures.

France represents slightly more than a fifth of the market (more than 1.2 billion francs in 1985). Heavy government investment in the computer field - in excess of 10 billion francs - will be a hallmark there. The French auto industry "has been quick to adopt electronic systems", though more rapid growth will occur in other industrial areas.

A survey of the study's other finding shows full custom circuits to comprise 41 per cent of the market, and gate arrays, a third. Each of these product types is significantly larger in volume than standard cells, fused programmable logic, or silicon compilers, the other types analysed. Automotive and military/aerospace end users will be among the fastest growing, though telecom and information systems are the largest sectors. Ferranti is found to hold the largest market share among suppliers. (Electronics Report, Ireland, November 1986, p. 10)

18 per cent growth forecast in Euro programmable controller market

European industry may question when and how to organize production under thorough-going computerized networks, but their purchases of programmable controllers will continue to surge none the less, according to a new research report from Frost & Sullivan.

The study, "Programmable Controller Networks in Europe", forecasts an average annual growth rate of 17.8 per cent for the total programmable controllers market to $1.4 billion in 1991 from $530 million in 1985. (Constant 1985 dollars are used throughout the study.)

Networked applications of medium-sized controllers - those with 129-896 I/O (input/output) channels - are expected to grow fastest of all with average annual increases in consumption of 24.9 per cent from $39 million in 1985 to $148 million in 1991. However, the category will still only account for 10 per cent of the total.

The largest category, as well as the second-fastest growing, is stand-alone medium-sized controllers. Frost & Sullivan predicts 20.4 per cent per annum growth from $141 million to $430 million, or 30 per cent of the total, over the forecast period.

Networks make factory-floor operations, where programmable controllers are used, the base of a pyramid-shaped automation scheme with corporate management issuing orders and receiving reports at the top. Layers of plant and process management fill in the rest of the pyramid.

However, in view of the considerable cost of complete automation networks, many potential users hesitate to commit themselves, according to the report, preferring to install programmable controllers and other automation hardware which will be capable of operating within a network system at a later date.

Besides cost, incompatibility of each manufacturer's network scheme with that of other manufacturers has been a problem. Users with any interest in networking have felt forced to stick with a single supplier. But General Motors' Manufacturing Automation Protocol (MAP) is an attempt to deal with this problem by creating a standard data communications scheme which, if designed into future products, would allow components to "talk" to each other regardless of manufacturer.

Most of Europe's programmable controller suppliers have launched, or are close to introduction of, MAP-based equipment. In France, however, an alternative common standard, known as JBUS, has been adopted.

The market is also analysed by end-user group, with Frost & Sullivan expecting by far the fastest growth - averaging 26.6 per cent per annum - in the food and beverage industry, where automatic control makes fast changes among small batches of product viable.

The Federal Republic of Germany dominated the European market for programmable controllers in 1985 with 47 per cent of the total, and is forecast to have 54 per cent by 1991. (Electronics Report, Ireland, November 1986, p. 7)

Industrial terminals for data collection in Europe

The collection of data requires hardware with particular characteristics that depend on the type of environment in which it operates. Thus, besides the most widely distributed data acquisition stations of the tertiary sector, we have those in industrial environments. The use of the latter, according to a study made in Europe by Frost and Sullivan, will increase as a consequence of the increasing introduction of CIM (Computer-Integrated Manufacturing) systems. In 1990, they are expected to achieve a market of 90,000 units. The present population is only 11,400 units.

The main sectors in which they are used are: the manufacture of automobiles, the aerospace industry, mechanical construction, electrical construction, the chemical industry, and the foods, beverages and tobacco industries. The countries in which their use is most widespread are: the Federal Republic of Germany, the United Kingdom, France, Italy and the Netherlands. Their use will increase particularly in the plastics, textile, paper, printing and packing sectors. Data collection stations in industrial environments normally consist of a console with keyboard, a screen, an automatic data reading device and a transmission connection that communicates with the central computer. (Bulletin IBIPRESS, No. 109, 30 November 1986)

Bubble memories

The announcement by Intel Corp. last month that it had signed a letter of intent to sell its bubble-memory operation marked the end of an era. Intel's decision meant the last major US semiconductor manufacturer involved in bubble memories was abandoning the field to the Japanese and two US start-ups, MemTech Inc. and Magnesys Inc.

MemTech and Magnesys don't intend to abdicate the market to the Japanese without a fight. MemTech is being formed to take over the Intel Magnetics operation in Folsom, Calif., and will gain access to the considerable research and development Intel put into bubbles. Magnesys, San Jose, Calif., is emphasizing subsystem-level memories, and it has developed its own wafer-level functional tester and circuits for its subsystem products that help improve yields from bubble wafers.

But with Intel gone, Hitachi Ltd. and Fujitsu Ltd. of Tokyo are the only giants left in the bubble business. Both are working on the next generations of bubbles - 16-Mb devices, which are due toward the end of this year, and 64-Mb devices, expected in 1990. They, along with NEC Corp., a relative newcomer, are also exploring advanced Bloch-line technology for future parts.

The question for the US companies is whether they can catch up. Each is confident it can. Although the companies themselves are young, both stand to benefit from the accumulated experience of US bubble-memory pioneers.

The innovations of Magnesys and the cache of technology MemTech gets from Intel will help make the two companies worthy bubble competitors for the immediate future. But they face formidable opponents.

Hitachi is already moving away from an early-generation technology based on bubble-propagation patterns formed of permalloy and toward a new ion-implantation technology for its 16-Mb devices. Ion implantation of the garnet film affords the same capacity in one-third the chip area required by the permalloy approach.

Current bubble memories use permalloy patterns shaped like chevrons. Hitachi's new devices, by contrast, propagate bubbles along patterns of contiguous disks created by implanting large doses of ions. A 1-bit cell measures $3.5 \mu m^2$, compared with a $6\text{-}\mu m^2$ cell for permalloy technology; ion-implanted parts due in 1989 will have $2\text{-}\mu m^2$ cells. Smaller chips built with improving implantation techniques will cost less. Hitachi expects to make 16-Mb parts that "will sell for less than current 4-Mb devices," says Edward Klink, Hitachi America's bubble-memory marketing development manager.

"Hitachi is already perfecting technology that will enable it to make a 256-Mb device by the mid-1990s, and eventually a gigabit device," says Klink. At these capacities, bubbles become competition for low-end Winchester drives.

Fujitsu also is developing its 16-Mb bubble components with ion-implantation techniques. To improve area efficiency, the 16-Mb parts will be built as two stacked 8-Mb chips, with both chips controlled by the same rotating magnetic field. Each 8-Mb chip will be about the same size as Fujitsu's current 4-Mb chips. The company says it will be offering samples of the 16-Mb part sometime during the next fiscal year, which begins in April. Development of 64-Mb parts has begun but is still in its earlier stages.

Beyond 64-Mb, Bloch-line technology may turn out to be the way to go. In Bloch-line devices, a single bubble carries more than 1 bit of data - perhaps as many as 100 bits in a single stripe-shaped bubble about $0.5 \mu m$ wide. The individual bits are represented by changes in polarization within the wall of the bubble domain.

Fujitsu and Hitachi are researching this technology, as is NEC Corp., which does not currently have a commercial bubble-memory line. Both Hitachi and NEC say they have working versions of experimental Bloch-line devices that store a handful of bits each, but practical chips appear to be a long way off. (Reprinted from Electronics, January 1987, pp. 102-103, © 1987, McGraw Hill Inc., all rights reserved)

Wafer-scale integration still going strong

For a while it looked as though WSI was an impossible dream, one that had eaten up millions of dollars and frustrated leading semiconductor companies and researchers. What has saved WSI is a turn away from the ambitious goal of integrating onto a single wafer all the different ICs needed for a system. Now companies are working along two more cautious routes: wafers that integrate repeated structures, such as memory cells, connected by multiple levels of interconnection, and hybrid-like silicon-on-silicon assemblies in which the wafer constitutes a substrate of interconnections onto which ICs are bonded.

Among the companies taking the first approach are Inova Microelectronics and British companies such as Plessey and Sinclair Research. The hybrid camp includes Mosaic Systems and GE. Also, TRW, GTE, and Honeywell are pushing slowly toward WSI by building ever-larger chips; in Honeywell's case, hybrid-circuit techniques are being used as a part of the interim solution. GM/Hughes Aircraft Co., meanwhile, is working on an ambitious project that not only involves building monolithic WSI, but stacking a number of wafers together as well.

One attraction of WSI is that it reduces the number of pin connections that can fail in a system. But the main reason so many keep plugging along is that semiconductor density improvements are slowing down, just as systems-level users in the military/aerospace industry and other are calling for a leap forward.

The silicon-on-silicon hybrid approach solves the yield problem for wafer-sized subsystems with a mix of IC types; individual chips can be tested prior to mounting on the substrate. A leading proponent of the hybrid approach is Mosaic Systems Inc., Troy, Mich., which is selling its electrically programmable Unipro substrates in two sizes - either a 4-in. wafer or a 1-by-1-in. segment. "But its chairman and chief technical officer says that without exception customers are more interested in the 1-by-1-in. segments than they are in the 4-in. wafers, because of "engineering reasons that start with the packaging." One, two, or three of the 1-by-1-in. segments can be put into existing commercial and military-qualified packages, whereas the wafer-size Unipro substrates cannot.

Also going the hybrid route is General Electric Corp., Schenectady, N.Y., working in conjunction with the Center for Integrated Electronics at Rensselaer Polytechnic Institute in nearby Troy. GE's director of semiconductor packaging says the advantage of building a silicon substrate is that "It's an easy substrate to put through photolithography." It's not much different from a printed-circuit board, he says, "but you can have a grid on a 2-mil pitch as opposed to the 20-mil pitch on a pc board. You have 10 times the density."

The more traditional monolithic wafer-scale approach still has a raft of proponents, such as Inova. Its Inroute methodology is a test-before-connect scheme, using deletive hard-wired connections and a common second-metal mask. Two key benefits are individual die testing and standard, low-cost processing. Inroute does not depend on error-checking or majority-voting schemes to boost yield, but it can be used to build such circuits if necessary.

Another member of the monolithic camp is the Massachusetts Institute of Technology, where until recently researchers were using a laser to form additive links after wafer processing is done. This technology requires complex new techniques, so the goal at the MIT Lincoln Laboratory has been to develop a more practical link technology that uses standard CMOS processes. The laboratory is now demonstrating a WSI dynamic time-warping circuit for speech memory.

The British are also pursuing monolithic WSI. Among the aims of the UK's Alvey fifth-generation computer project is the study of fault-tolerant WSI - in which yield is enhanced by switching in redundant circuit elements to replace faulty ones - in an attempt to gain an edge in what the project's principals consider to be the technology of the 1990s. Managing the project is the Plessey Co., working in conjunction with General Electric Co. plc's Hirst Research Center, International Computers Ltd., and several British universities. Test cells incorporating such regular circuit structures as random-access memory and multipliers will be combined in demonstration circuits and at least one full 4-in. WSI part by 1990.

Commercial WSI parts could emerge within the next year from Anamartic Ltd., Cambridge, UK, a company set up earlier this year by Sinclair Research Ltd. The first product, a 160-megabyte RAM using 1.25-μm n-MOS, is due in early 1988.

In the US, TRW Inc.'s Electronic Systems Group in Redondo Beach, Calif., is building what it calls "superchips" - parts larger than standard ICs by a factor of 3 to 10, using WSI methodologies. GTE Laboratories, in Waltham, Mass., is also taking an evolutionary approach. Rather than leaping directly into WSI, it is moving slowly to larger ICs.

Straddling the boundary between monolithic and hybrid approaches is Honeywell's Corporate Solid State Laboratory in Plymouth, Minn. Honeywell is fabricating very large CMOS chips, typically 0.7 to 1.0 in. on a side and containing several functional cells. These chips can then be put down in a hybrid-type package.

The most impressive system-level effort to date in monolithic WSI is the 3-D Computer Project of the Exploratory Studies Department at Hughes Research Laboratories, Malibu, Calif. The Hughes team is building an image-processing cellular array of stacked CMOS wafers that has one processor for each pixel. The team believes that by stacking wafers fabricating feedthroughs and interconnections, it can create massively parallel communications channels on, between, and passing through wafers. Funded under a Defense Department contract to build a feasibility demonstration machine, the machine currently being developed will be 32-by-32-processor array in a five-wafer stack. (Reprinted from <u>Electronics</u>, 8 January 1987, © 1987, pp. 94-95, <u>McGraw Hill</u> Inc., all rights reserved)

<u>Automated "monster" IC plants may be an expensive mistake</u>

Led by the Japanese, the rush by the world semiconductor industry to highly automated, 6-in. wafer "monster" plants is now being called an expensive mistake by leading industry consultants. And the next step, to 8-in. wafer lines, has hit an economic and technical stone wall. The result, they say, has been a growing number of Japanese plant closings, cancelled construction plans - and maybe a golden opportunity for US chip makers to catch up.

These dramatic views were first aired in late January by Jerry D. Hutcheson, founder of VLSI Research Inc. in San Jose, Calif., an expert on semiconductor production equipment. He is challenging what has been regarded as a bedrock truth: economies of scale are the key to prosperity. The reasoning has been that the bigger the wafer and the more automation, the more good dice at a lower cost. Such attitudes had led to the huge automated 6-in. wafer fabs that can crank out up to 10,000 wafer starts per week. These plants cost upwards of $150 million each, and the Japanese alone have committed to build about 40 since 1984.

But today's lagging markets are not the same as the markets of five years ago, when the Japanese were taking market share with high-volume production of dynamic random-access memories and could afford to build the huge plants. "They are finding the plants don't work profitably today," Hutcheson says - so start-ups have been delayed, and plants have either been closed or downsized.

The question now is, what effect will all this have on US plans to compete against the Japanese, their monster plants, and their supposed economies of scale? Being discussed now are two similar proposals: a Pentagon-supported US manufacturing consortium and an industrial plan to set up a manufacturing co-operative (Sematech). As far as Hutcheson is concerned, there is a role for such a co-operative. "I'm still for it," he says, but adds that the key to making a US manufacturing co-operative work is plant flexibility.

Hutcheson's conclusions are seconded by other experts, such as semiconductor analyst Daniel J. Rose, who track the business. For example, recent data from Integrated Circuit Engineering Corp. of Scottsdale, Ariz., shows that some Japanese companies are indeed backing off from 6-in. production (see table).

The problem, says Hutcheson, is sluggish growth leading to overcapacity. On top of that, Hutcheson says, the automated equipment is designed to perform at top rates for peak efficiencies and cannot easily be scaled back to lesser volume: "The plants are inflexible because these systems are essentially bolted together," he says.

So when demand is flat or lower, production is cut, and expenses climb to the point that operations "can be enormously unprofitable," says Hutcheson. Also, the mix of semiconductor type has changed from high-volume commodities to ASICs. The implications for the US chip industry could be profound, he thinks. "Americans [merchant market suppliers] never built the monster plants, but that can work to our benefit. For the first time in 10 years, the US has a chance to catch up." US makers rely on smaller, more flexible plants, he says. Since these plants are now being upgraded to improved processes. US suppliers are better attuned to today's demand for short-run ASICs.

Attaining true flexibility in chip manufacturing is a task that causes headaches for US companies too, says Theodore Malanczuk, vice president of manufacturing at National Semiconductor Corp., Santa Clara, Calif. The software for controlling automated process lines is so much different for ASICs that "generating this software is a monumental task," he says. "Japan has generated software for commodity items; they will have to go back and regenerate for custom. That is something the US is struggling with now."

As for 8-in. wafers, Hutcheson says, "the trend is slowing, possibly disappearing." The Japanese think there's no need for the bigger wafers and believe that they are technologically beyond the state of the art. Keeping to a ±5 per cent tolerance across 8 inches is the main bottleneck. So IBM Corp. and Texas Instruments Inc. are the bellwethers of the 8-in. world, with perhaps eight plants between them on-line or planned, Hutcheson says. IBM, in fact, announced last week that the megabit chips in its new 3090 processors were fabricated on 8-in. wafers.

Asians delay some 6-in. wafer production

Company	Facility location	Installed capacity (wafers/month)
Fujitsu	Iwate	22,000
	Mie	10,000
	Wakamatsu	10,000
Hitachi	Kofu	15,000
	Mobara	15,000
	Naka	Closed
	Ohme	Delayed indefinitely
	Hokkaido	Opens 2nd quarter 1987
Hyundai	Inchon	Opened 4th quarter 1986
Matsushita	Arai	Delayed indefinitely
	Uozu	Opened 4th quarter 1986
Mitsubishi	Kumamoto	Delayed indefinitely
	Saijo	Delayed indefinitely
	Kochi	Opens 1st quarter 1987
NEC	Kumamoto	25,000
	Yamaguchi	20,000
	Livingston, Scotland	Opens 1st quarter 1987
Oki	Miyazaki	Opened 4th quarter 1986
Ricoh	Osaka	10,000
Sony	Niigata	Delayed indefinitely
Sharp	Fukuyama	Opened 3rd quarter 1986
Toshiba	Oh-Ita	20,000
	Iwate	Opened 4th quarter 1986
Total	-	147,000

Source: Integrated Circuit Engineering Corp.

(Reprinted from Electronics, 5 February 1987, p. 29,

British Government funds gallium arsenide research

Research into gallium arsenide, as a material for building fast semiconductor devices, is being give a £25 million boost by the Government. The Department of Trade and Industry has earmarked this funding as a slice out of the Support for Innovation scheme over the next two years.

Gallium arsenide research has not been part of the Alvey programme. Hitherto it has been funded mainly by the Ministry of Defence - to the tune of £2 million a year since 1977. This funding will continue.

Information technology minister Geoffrey Pattie says further government support "aims to encourage early exploitation of gallium arsenide". It hopes to develop marketable products, to avoid fragmentation and duplication of effort and to face up to growing US and Japanese competition. (Computer Weekly, 22 January 1987, p. 8)

Thomson to tap fresh GaAs field

Thomson Semiconducteurs claims it has broken new frontiers in integrated circuit technology with the creation of a prototype 0.5 micron transistor that introduces indium in an alloy with gallium arsenide.

The technology involves depositing molecules of indium, which has the same atomic pattern as gallium, on a gallium arsenide wafer, in order to create an alloy. The replacement of gallium electrons by those present in indium is a relatively straightforward process, according to Thomson.

The first tests have shown that, at 18 GHz frequencies, the gain in power between input and output is tenfold, equivalent to the best performance by a GaAs circuit.

The French firm forecasts a major role for its new transistors in new military radars and antennae.

Thomson has kept two engineers busy full time since the early 1980s on developing the gallium arsenide-indium chip.

Thomson's achievement now establishes it firmly as a rival for the laboratories of IBM, AT&T, NEC, Fujitsu, Plessey and British Telecom in introducing advanced chip technology. (Electronics Weekly, 28 January 1987)

Profits reduced and jobs cut at IBM and ATT

Ten thousand IBM employees in the US have accepted early-retirement incentives from the company, thus leading to a one-time charge of US$250 million in the last quarter. Meanwhile, ATT has set aside US$1 billion in order to cut 27,400 jobs. Both steps have been due to the slump in profits that was particularly sharp for the two companies in the last quarter of 1986.

The annual net income of IBM has been down for two consecutive years. The US$4.79 billion the company earned last year represented a 27 per cent fall in earnings from the previous year. Fourth-quarter net income was down 48 per cent. Annual earnings at ATT have plunged from US$1.55 billion in 1985 to US$139 million in 1986. Earnings in the final quarter likewise played a large part in this negative performance. Profits reached US$1.48 billion over the first three quarters, but a US$3.2 billion restructuring plan announced during the fourth quarter ate up US$1.7 billion of the profits for the year.

ATT was broken up into 22 regional telephone companies following the deregulation of telecommunications in the US. In January 1984, the company had 385,000 employees. Now, it has 321,000. By the end of this year, it plans to have only

290,000. According to company officials, the positive results of the adjustments and restructuring now being undertaken will not be felt until 1988. When Ma Bell was broken up, US$10.5 billion was designated for equipment renovation. Now, a restructuring plan which will cost US$3.2 billion has been launched. The cost includes US$1 billion to cut jobs, US$1.2 billion to improve the physical plant and US$1 billion to reduce capacity in certain areas. (Bulletin IBIPRESS, No. 115, 8 February 1987)

Siemens joins the 1-Mb dram club

Siemens AG is about to take its first big step in an all-out drive to propel itself into what the Federal Republic of Germany giant calls the "mega era" of the semiconductor industry. Lagging only major Japanese suppliers, Siemens next March will start sampling a 1-Mb dynamic random-access memory to its customers.

The big chip is just the beginning. New facilities that will come on line next year, such as a new mask centre, a process line for high-speed bipolar devices, and a design centre for application and customer-specific CMOS circuits, will contribute greatly to Siemens' drive. Coupling these facilities to the Federal Republic of Germany company's experience as a systems manufacturer will add greatly to Siemens' clout in the European semiconductor markets, predicts Peter Savage, associate director and a components market watcher at Datquest UK Ltd. in London.

The Munich company's efforts in 1- and 4-Mb DRAMs are part of the Mega project, which Siemens and Philips International NV jointly launched in 1984. This $2 billion endeavour, partly financed by the Dutch and Federal Republic of Germany Governments, envisions 4-Mb Siemens DRAMs by 1989 and 1-Mb Philips static random-access memories also by 1989. The company is one of three European manufacturers that, under the Joint European Silicon Submicron Initiative (JESSI) want to set up a common research institute for developing a 0.3-μm technology. Philips of the Netherlands and the Thomson Group in France are also JESSI partners.

By sampling the 1-Mb DRAMs next spring, "Siemens is right on schedule". Being on schedule would not have been possible for Siemens, however, without help from Toshiba Corp. Under a technology-exchange agreement with the Japanese company Siemens acquired the mask-fabrication technology necessary for making the devices. That has enabled Siemens to cut the time it had lagged other firms in getting memories to market. In the past, its lag time had been running 2 1/2 years, but with the boost from the Japanese, it now is only about half that. And with its 4-Mb devices - which Siemens will make entirely on its own - the company thinks it will pull even with its Far Eastern and US competitors.

To that end, engineers at Siemens' Central Research Laboratories in Munich have tested parts of their 4-Mb DRAMs, which will be made with 0.8-μm lines. Thanks to JESSI, Siemens is even eyeing 0.3-μm, 64-Mb devices.

Produced at Siemens' Regensburg plant, the 1-Mb DRAM uses 1.2-μm CMOS technology. The 1-Mb-by-1-bit DRAM will come with maximum access times of 100 and 120 ns and will draw either 330 or 275 mW. The 54 mm^2 chip comes in a standard 18-pin dual in-line plastic package, which is the same size used for 16-, 64-, and 256-K memories. Around mid-1987, the 1-Mb DRAM will be available in a surface-mountable package.

Volume production of the 1-Mb DRAMs will be gradually stepped up during 1987. The production line is geared for 6-in. wafers, in contrast to most of the competition, which still works with 5-in. wafers.

About the same time that volume production of 1-Mb DRAMs gets under way, Siemens' mask centre and process line for high-speed bipolar logic circuits will come on stream. This facility, in Munich, will concentrate on emitter-coupled-logic arrays with gate delays initially around 200 ps. Another project due to come on line next year is a design centre for CMOS ASICs and customer-specific circuits. So by the end of 1987, Siemens should be in a strong position to run with the Japanese and US chip makers in the mega area. (Electronics, 13 November 1986, p. 30)

Big chip is set for PC domain

IBM has announced that a new generation of memory chips will be built into its enhanced 3090 mainframe range, helping to boost processing power for users by up to 60 per cent.

Yet it should not be long before such chips, with a capacity of one Mbit - at present a luxury that only mainframe users can afford - will be standard in every PC. Next year could see the start of that process.

Demand for Mbit memory chips is low at the moment, but as prices come down and the devices become more readily available they will become the standard commodity chip. Over 5.5 million Mbit chips were shipped in 1986, according to market research firm Dataquest, the number is expected to increase tenfold in 1987.

Apart from mainframes, the first machines to take advantage of the one Mbit chip will be superminis and graphics workstations, which perform memory-intensive tasks. When the price is right the Mbit chip will replace the 256 Kbit chips found in PCs today.

But as chip technology advances quicker, the lifespan of products shortens. The 16 Kbit chip lasted three to four years, the 64 Kbit chip three years, the 256 Kbit chip about two years. It is likely the one Mbit device will have a lifespan of only one year before it is overtaken by four Mbit chips. ... (Computer Weekly, 19 February 1987, p. 17)

Megachip announcements

IBM has announced that it has designed and produced a memory capable of storing 4 megabits (millions of binary digits) in an integrated circuit (chip), 35 per cent greater than the strongest memories of 1 megabit available at present. The Japanese telecommunications company, Nippon Telegraph and Telephone (NTT), has announced the details of its 16 megabit memory. Both announcements refer to the typical directional memory (dynamic RAM) and both cases are prototypes which in the best of cases could take one or two years to become commercially exploitable.

From these announcements, coupled with the previous announcement by Texas Instruments for a 4-Mbit chip, radical changes in microcomputers, which still today are basically chips of 256 Kbits, can be foreseen. Not only will the problems be overcome of the full exploitation of the services offered by microprocessors such as the Intel 80236 which is capable of directly managing 16 megabytes (millions of characters) and of the DOS operation system with regard to fully overcoming the 640-Kbytes barriers, but also the easy use of complex expert systems, orthographic dictionaries, high resolution graphics and rapid RAM disks can be foreseen. It is precisely these possibilities that will make the request for such memories soar and will render their production profitable. (Bulletin IBIPRESS, No. 120, 15 March 1987)

Thomson joins flanks with the Italian GGG

The French company Thomson which operates in the electronics sector has reached a collaboration agreement with the Italian semiconductor manufacturer GGG. The French company had been seeking partners for some time to enable it to expand its own capacity to penetrate the semiconductor market. For this reason it acquired Mostek last year from United Technology in the USA.

The programme which Thomson and GGG intend to develop will have a global cost of US$229 million and a duration of four years. It is also expected to take part in Eureka's European project for high technology.

The plans for collaboration between the two companies foresee the development of a new generation of 4 megabit EPROM type (erasable programmable read-only memory) chips, as opposed to RAM (random access memory). This type of integrated circuit is not subject to alterations of memory, even if the central system is deactivated. (Bulletin IBIPRESS, No. 113, 25 January 1987)

Two German giants team up to take on IBM

Does one plus one make a powerful twosome? Two Federal Republic of Germany companies - chemicals giant BASF and Siemens, the Munich-based electronics company - hope so. They're teaming up in a 50-50 venture to create Europe's biggest supplier of IBM-compatible mainframe computers. Neither company is a stranger to the market: BASF already sells Hitach mainframes and peripherals, while Siemens supplements its IBM-incompatible computer line with IBM-compatible Fujitsu products. Once they begin combined operations on 1 January 1987, the two companies expect to have 1987 revenues of $500 million, or about one-third of Europe's IBM-compatible market.

With national names and strong marketing and service networks, the BASF-Siemens linkup "will be very well established," says Gerhard Adler, president of consulting firm Diebold Deutschland. Although BASF and Siemens say their chief target is International Business Machines Corp., some see them posing a potent threat to such US companies as Amdahl Corp. and the National Advanced Systems unit of National Semiconductor Corp., especially in the big German market. (Business Week, 24 November 1986)

ATT and Olivetti reach new agreement

After the successes obtained on the European market, which in 1985 saw Olivetti in second place in the sales of professional PCs and in first place in the Italian market of the sector, the Ivrea house has recently reconfirmed for 10 years and extended the scope of its collaboration agreement, begun in 1983, with the USA mammoth in communications, ATT.

The new arrangement provides Olivetti with the exclusive authorization to produce the entire range of each of the two professional personal lines. Moreover, steps have been taken that favour the joint formulation of informatics strategy by the two groups, with particular regard to the development of integrated systems in telecommunications and informatics.

The decisions taken by ATT to review the agreement with the Italian group matured following the losses the American firm experienced in the informatics sector. It seems in fact that the telephone giant recorded disappointing sales indices, except for the P6300 personal computer produced by Olivetti. The expected losses amount to approximately US$800 million.

Things are going differently for Olivetti however. According to a classification published by Datamation, it ranked second among the top 25 European companies in 1985 in sales of professional PCs, with an 11 per cent share, outdone only by IBM with a 30 per cent share of the market. (Bulletin IBIPRESS, No. 106, 11 November 1986)

Fujitsu to buy into Fairchild

Fujitsu of Japan and Fairchild Semiconductor have signed an agreement in principle whereby the Japanese company is to buy a majority holding in Fairchild. Fujitsu is acquiring 80 per cent for an undisclosed amount, while Fairchild's parent Schumberger will retain 20 per cent. It is understood that Don Brooks will remain as president and chief executive officer of Fairchild, and the US and European operations of Fujitsu Microelectronics will be folded into Fairchild. Brooks will remain on the board of directors of what will become a new international company based in Cupertino.

The new company may be modelled along the lines of Amdahl, which is now controlled by Fujitsu. It is expected that Fairchild's products will be sold in Japan by Fujitsu, but the Fujitsu semiconductor division there will remain organized and owned as they are.

Fairchild has been slipping down the semiconductor manufacturer's league for some time now. In 1985 its IC revenues totalled about $465 million, and analysts have forecast that an increase in IC sales this year should produce revenues of just over $500 million. The combined output of the two companies is forecast to produce some $2.2 billion worth of semiconductors this year according to one report. That would put Fairchild/Fujitsu about equal to Hitachi which is forecast for $2.27 billion, a little more than Toshiba which is forecast for $1.975 billion, but substantially short of NEC which is forecast for $2.865 billion. (Electronics Report, Ireland, November 1986, p. 5)

Motorola, Toshiba sign chip pact

Motorola and Toshiba have reached a preliminary agreement on an exchange of products and technologies and a joint manufacturing venture in Japan. As part of the agreement Toshiba says it will actively support Motorola's access to the Japanese market.

The deal will also propel Motorola back into the dynamic RAM (DRAM) market. Toshiba will transfer its MOS manufacturing process technology and representative DRAM and static RAM (SRAM) designs to Motorola manufacturing facilities worldwide. Toshiba will purchase certain 8-bit and 16-bit microprocessors in the near term, and in the longer term, it will purchase 32-bit microprocessors from Motorola.

The agreement also calls for the mutual periodic transfer of technology through to 1991 to the jointly-owned manufacturing facility, as Motorola's semiconductor operations gain more access to the Japanese market.

The facility will be located in Sendai, Japan and it will produce 256K, 1Mbit and 4Mbit DRAMs and 256K and 1Mbit SRAMs using Toshiba designs and technology. It will also produce 8-bit, 16-bit and 32-bit microprocessors using Motorola's HCMOS designs and technology. Production is expected to begin in the first quarter of 1988.

This preliminary agreement is subject to the signing of definitive agreements. Both parties stress the transaction covers only MOS semiconductor products. The agreements should be completed by the end of 1986. (Electronics Weekly, 3 December 1986, p. 3)

Japanese companies moving into Europe

The recent move into Europe of the Japanese group NEC, following a similar move by the Toshiba group, is a reflection of the growing presence of semiconductor manufacturers in the region. Toshiba has decided to initiate large-volume production of the latest generation of memory chips for domestic and other products. The chips are one-megabit, or one-million bit, semiconductor products.

The production of the one-megabit chips, which have four times the power of the previous generation of semiconductors, began last month at a plant in Braunschweig, Federal Republic of Germany. When in full production the plant is expected to turn out around 100,000 chips per month. Toshiba has not yet installed manufacturing lines at the Braunschweig plant. It has decided instead to import components for local assembly and testing. In this, Toshiba is behind Siemens, the only European semiconductor manufacturer to have begun production of one-megabit chips on a small scale.

However, specialists do not expect the German company to seek to become the leading manufacturer in the sector, and, according to them, Toshiba will automatically acquire a strong position. The other Japanese computer group, NEC, which has installed full-scale production lines at its plant in Scotland, recently became the largest manufacturer of semiconductors in the world.

It is clear that the first manufacturer to enter the market with a new-generation chip can exert enormous influence on the design of many products and, thus, corner a sure share of clients.

According to a study carried out by Dataquest, the European market for one-megabit semiconductors should be rather modest this year, with production of only three million units. However, production is expected to reach 20 million units in 1988 and 60 million units by 1990. (Bulletin IBIPRESS, No. 116, 15 February 1987)

14,000-gate Honeywell IC leads next bipolar wave

A new semicustom logic array called the HE12,000, from Honeywell Digital Product Center, raises the gate-count ante for bipolar parts well over the 10,000 mark while offering 150-ps propagation delays and typical power dissipation of 9 W and worst-case dissipation of 15 W.

The new chip is part of the next wave of bigger, faster commercial bipolar arrays aimed at keeping powerful computers percolating on data and programs without the need for expensive liquid-cooling systems. Close on Honeywell's heels are the likes of Fairchild, Motorola, and Texas Instruments, which are expected to announce arrays made from new emitter-coupled logic processes.

But Honeywell is making its bid with the same 1.25-µm triple-level-metal bipolar technology it used a year ago to launch the 8,000-gate HE8,000. The process - a cousin of the 1.25-µm technology Honeywell used for its Phase I work in the military's Very High Speed Integrated Circuits Program - produces a speedy but power-stingy array of current-mode logic gates surrounded by ECL input-output circuits. CML cells are similar to ECL circuits minus the emitter follower. Without emitter followers, CML cells dissipate less power and have incresed density, says David Wick, bipolar product manager.

Although the majority of computer applications will continue the migration toward high-density CMOS semicustom ICs, a small but determined group of mainframe and supermini manufacturers will continue to ask for faster and bi-ger bipolar chips. That's the view of Dean Winkelmann, who tracks application-specific logic ICs at Integrated Circuit Engineering Corp. of Scottsdale, Ariz.

He estimates ECL and bipolar parts will shrink from a combined [illegible] per cent share of $1.29 billion gate-array sales in 1986 to only 22 per cent of $3.35 billion by 1991 (see table).

Even though the market is getting smaller, others have no intention of leaving it all to Honeywell. For example, Motorola is expected to introduce soon a high-density ECL gate array based on an extension of its Mosaic II process using a new structure called a polyelectrode transistor. Fairchild, likewise, is expected to apply its latest bipolar process, called Aspect to high-performance bipolar arrays. And England's Ferranti Electronics Ltd. announced last autumn a fast, low-power 10,000-gate bipolar array using a new third generation of its collector-diffused isolation process.

Bipolar: still a good niche

	1986	1991
Worldwide market ($ billions)	1.285	3.35
CMOS	66%	76%
ECL	21%	14%
Bipolar	13%	8%
GaAs	-	2%

Source: Integrated Circuit Engineering Corp.

Success of Motorola's MC6800 series of Motorola

Motorola has announced that the MC68030 microprocessor with the extended floating point MC68882 coprocessor will make it possible to double the services of the 68020 which works with the 68881 coprocessor. This should increase the success Motorola has had with the 68000 series on the 32 bit microprocessor market. The very rational architecture of such microprocessors, coupled with the fact that Intel the leader in 16 bi microprocessors was behind in presenting its 32 bit microprocessor, the 80386, have contributed to such success.

The 68030 will offer complete upward compatibility, in other words it will be able to process the programmes created with the whole range of the microprocessor family initiated in 1979 with the 16 bit MC68000. Besides Intel, the major competitors to the 68020 are the 32332 of National Semiconductor, the WE32100 of the ATT and the Z80000 of Zilog. The market for which they are contending will reach 4.7 million units by 1990.

In any evaluation of a microprocessor, the coprocessor which accompanies it should be considered. These coprocessors are integrated circuits as or more complex than the actual microprocessors which operate with it, enabling its services to be almost on a par with those of a mainframe. They represent therefore a way of making up for the limitations in the current circuit integration technology. (Bulletin IBIPRESS, No. 121, 22 March 1987)

COUNTRY REPORTS

Argentina

Process control for petrochemical units

Petroquimica General Mosconi has embarked on a wide-ranging modernization of its petrochemical complex in a move to upgrade product quality and keep its large export business. One expansion project, already in progress, is a new olefins unit. Licences and basic engineering have been contracted with European suppliers.

The second expansion project will produce dimethyl-polyethyl-terphthalate from the paraxylene that PGM now produces and exports. Basic engineering for this job has been contracted to German companies. The plant will have a starting production capacity of 62,000 tons per year, and it is expected to begin operation in late 1988.

Although the initial goal of PGM was to supply the domestic market, it sought exports as a major revenue source. It was remarkably successful. At present, 30 per cent of its output supplies the domestic market, and the remainder is exported to the USA, Britain, Italy, Japan, Holland, Germany, Brazil, Spain, China, Mexico and Korea.

Exports during fiscal year 1984-85 was distributed as follows: USA, 56 per cent; Europe, 27 per cent; Latin America, 13 per cent; other countries, 3 per cent.

The new plants as well as the existing units at Ensenada will be provided with a new process control technology to replace its present control systems. Two years ago a technical study was conducted, to seek measuring and control equipment with higher precision, operating versatility and faster response rates. Management also wanted more data on each of the unit's operations. A distributed control system called Spectrum recommended by Foxboro Argentina S.A. was chosen.

First installation of Spectrum was done at the pyrolysis gasoline hydrogenation plant. Later, it was hooked up to the hexane plant.

Spectrum features a regulatory control unit, a CRT-based work station, and a communication link called Foxnet. It facilitates system integration. This network communicates via coaxial cable. It permits communication between distributed process units up to 15,000 feet apart, and dramatically lowers installation and wiring costs. Its one-megabit speed allows efficient integration of large or complex systems.

The new control equipment includes an automatic printer which records the basic parameters for each process under control. The data facilitate quick analysis; with the previous systems, time was consumed by gathering detailed information at different points of the plant. (Industrial World, October 1986, p.17)

Canada

The B.C. Science Ministry and the Federal Ministry of State for Science and Technology have announced the formation of the British Columbia Advanced Systems Foundation. The purpose of the foundation is to set up an Advanced Systems Institute "to build strategic technology strengths in computer science, microelectronics, applied mathematics and robotics". The new institute will receive $8 million in funds from both ministries over five years. (Canadian Research, September 1986)

China

China to export PCBs

A group of 21 Chinese research institutes and factories has signed contracts with the US, Italy and Australia for the export of their printed circuit boards, Xinhua news agency reported. The group, which has automated production lines and produces advanced printed circuit boards, has also recevied orders worth Yuan 10m from domestic customers.

The research institutes and factories had combined their resources to produce the PCBs, which previously had to be imported because of inadequate production capacity. (Electronics Weekly, 11 February 1987)

EEC

ESPRIT reviewed

Background

The European Strategic Program for Research and Development in Information Technology (ESPRIT) was launched by the European Community in February 1984. It resulted from an initiative taken by the EEC Commission and a Round Table of 12 leading European information technology firms in response to growing concern over the European information technology (IT) industry's reduced competitiveness in the world market.

The program is to provide the research needed for competitiveness in the IT industry through collaboration among the European IT organizations and to pave the way for European standards.

Present status

Over a thousand proposals were generated as a result of the 1984 and 1985 work programs. Only one out of five could be supported. There are now about 200 projects with 450 organizations and involving about 2,000 people full time. The financial commitment to 1 July 1986 was 1.37 billion ECU ($1.1 billion). The Commission has published information for each technical area, giving general strategy, a summary of the work, contact point and project partners.

A few examples of ESPRIT projects are:

- Project 97 (advanced algorithms, architectures, and layout techniques for VLSI signal processing) has produced a solution for a particular type of architecture, among several being investigated, which is 10 times more efficient than the present state of the art. The project has also developed a CAD tool which, together with other existing tools, allows the completely automated design of complex integrated-circuit digital filters in less than a week.

- Project 440 (advanced message-passing architecture and description systems) has provided the basis for the development of a product (OMEGA, environment to develop knowledge-based systems) which has been announced on the market by Delphi, a small company that is the main contractor in the project.

- Project 623 (operational control for robot systems integration) has produced a report titled "Design Rules for Robot Integration into Computer Integrated Manufacturing". The project is investigating the problem of the integration of various technologies in CIM systems and will provide results applicable not only to industrial robots but also to material handling equipment.

- Project 232 (compound semiconductor materials and ICs) has already met some of its technology objectives. The success of the project, together with results achieved in other complementary programs by the same consortium (LEP, Plessey, Siemens, Thomson), has led to the realization of GaAs MESFET 256-bit static RAM circuits with access time of 1.5 ns. LEP has also announced the successful operation of a 1-kilobit static RAM with a longer access time (3.4 ns) but very low power dissipation.

- Project 107 (LOKI - logic-oriented approach to knowledge and databases supporting natural user interaction) has developed tools to optimize access to databases, thereby winning the supreme prize at the 1984 European Conference on Artificial Intelligence.

- Project 121 (handling of mixed text/image/voice documents based on a standard office documents architecture) has defined an office document architecture, resulting in recommendations to the European Computer Manfucturers Association (ECMA) and International Standards Organization (ISO) for standardization.

- Project 32 (PCTE - portable common tool environment), aimed at providing a supporting structure for a family of portable tools, has realized the first prototype based on ADA. PCTE will provide a common framework to serve as a basis for the development of tools for the writing of software. Emphasis will be on portability of the developed tools.

Some major technical achievements in state-of-the-art work in microelectronics include:

- A chip using 0.5-micron feature-size circuits and containing 1 million elements. This work was done by Matra-Harris, France and SGS, Italy.

- Bipolar and CMOS circuits on the same chip using over 30 process steps and 20,000 transistors. This was accomplished by Philips, Siemens, and Stuttgart University.

- An ECL bipolar switch has been constructed and operated at 200 picoseconds.

- A compound semiconductor using gallium arsenide has been demonstrated on a 1-kilobit static RAM with 300 nanosecond access time and low power consumption.

Some major achievements in PCTE are that:

- This project is establishing standard interfaces in tool development. EMERAUD, a French program for a common environment for software engineering, has adopted these interfaces.

- A common UNIX 5 interface has been established. It is called "x open".

- The US DOD is discussing a proposed computer-automated support equipment (CASE) vs. PCTE interface.

Plans for ESPRIT II

During an ESPRIT technical week held in October 1986, plans for ESPRIT II were considered. The focus will be on market requirements and a plan to have products on the market by 1992 that will be competitive in the world market. In microelectronics the emphasis will be on application-specific integrated circuits to meet market needs at reduced cost. An objective in information processing systems will be to improve by a factor of 10 the price performance of a complete system including hardware and software. In applications, emphasis will be on factory automation and office systems with an effort to establish common subsystems.

A task force held a series of workshops and consultations in February which has resulted in an outline package recommended by the Commission for a second phase roughly three times the size of the current programme - to 30,000 man-years of work.

The proposal suggests three technical work areas:

1. Microelectronics and peripherals. This requires restructuring of existing activity to include basic hardware and peripherals. The objective is to provide the Community IT industry with full system capability through access to up-to-date functional components and sub-systems based on state-of-the-art solid-state (especially semiconductor) technology. The effort should be divided between silicon technology, compound semiconductors, computer-aided design, and peripherals.

2. Information processing systems. This involves integration of existing AI processing and software areas to reflect the increasing convergence of the work. The objective is to provide capability of producing systems of similar complexity to those produced now with 10 per cent resources, and of producing highly complex systems. Emphasis will be on the systems approach, and the effort will be divided between system design, knowledge architecture, knowledge engineering, signal processing, and technology integration projects across all areas.

3. Integration of IT into application systems. This will include the development of existing office systems and computer-integrated manufacturing. The objective is to enhance European capabilities in the integration of IT into systems for use in a broad range of applications. The effort will be divided between:

- Generic technologies and methods in which R&D for technologies, tools, and subsystems can be used in a broad range of applications.

- Factory automation to support the competitive position of European manufacturers through flexible, reliable automated systems of production and to stimulate and increase participation by vendors.

- Office and integration information systems R&D for wide application, and with emphasis on human-activity support systems.

Comments

The ESPRIT program has just moved into the second half of its 5-year first phase. It is too early to assess its success overall. However, as confirmed during its mid-term review last fall it has made substantial progress in some areas. In particular, the work in microelectronics is impressive. The demonstration of 0.5-micron feature-size circuits containing a million elements is certainly state of the art. Also, its effect on collaboration among European companies from different countries will have substantial impact on the future of this industry in Europe.

The plans outlined for ESPRIT II with emphasis on products and applications will make it competitive with EUREKA. One can then ask why both programs. Of course, EUREKA covers a wide spectrum of industries and the whole of Western Europe as contrasted with ESPRIT, which only covers information technology in the EEC countries. ESPRIT is also more centrally co-ordinated than EUREKA appears to be.
None the less the question of overlap in the information technology area is bound to rise. (European Science Notes, November-December 1986)

The second stage of the Race programme

The European telecommunications programme which began in January 1986 was concluded at the end of the year. With a view to planning research for the 1986-1991 period, a meeting has been held of the authorities of the twelve countries of the European Community in order to prepare the second stage of the programme. Its culmination is to make it possible for Europe to have a wideband network based on a new generation of optical fibre systems which is to allow the rapid transmission of images, sound and data.

The European Community Commission has accepted a proposal of a research and development programme of the most advanced technologies with regard to telecommunications. The community's contribution to finance projects should amount to 850 million US dollars.

Around 30 of the programme's investments are to be destined to the study and testing of a number of Community standards in the field of wideband communication networks. This is an essential element in allowing the formation of a unified market in Europe that would make it possible for firm to attain a competitive size. The rest is to be destined to the development of technologies and for the equipment necessary to implement them. (Bulletin IBIPRESS No. 105, 3 November 1986)

Euro deal falters

Plans to set a budget for the next five years of European Community high-technology research are still in deadlock after the collapse of compromise talks.

Research ministers were intending to discuss a compromise introduced by the Commission at an earlier meeting but papers giving a detailed breakdown of its three-year, 7 billion budget proposal never appeared.

The UK, supported by France and FRG had argued for a £2 billion budget cut in the Commission's original £5.4 billion, five-year programme.

Research ministers had little difficulty in agreeing the next phase of pan-Europeen Eureka projects. Eureka has the same aim as EEC projects - to build European defence against US and Japanese technological competition - but it does not require the same specific commitment on funding.

At the recent ministerial conference in Stockholm 37 new projects, worth £525 million, were announced. The major project is a collaboration between Thomson, the French defence and electronics group and SGS, the Italian semiconductor maker, to develop a new generation four-Mbit Eprom (Erasable programmable read only memory) chip. (Computer Weekly, 8 January 1987, p.3)

Egypt

Computer training

The Engineering for the Petroleum and Process Industries Co. (Enppi) Computer Department conducted computer training courses for personnel of ASORC and El Nile Soap Co. during November and December. The Enppi courses employed new approaches to computer training: lectures were reduced to a minimum, with 70 per cent of total training hours devoted to hands-on training (the highest percentage currently offered in Egypt). The courses also included case studies in fields related to the trainees' backgrounds. The basic philosophy of the courses was that the trainees should learn, not about computers, but how to use computers to solve problems.

The syllabus included 40 hours of introduction to computers, 30 hours of Basic, and 40 hours of FORTRAN. Trainees worked both with personal computers and with mainframes. The courses followed a pattern which has been very successfully applied in Enppi in-house training, and it is hoped that this experience will now benefit Egyptian industry on a wider scale.

Federal Republic of Germany

German supercomputer

Suprenum is the name given to the supercomputer being developed under the direction of Professor Wolfgang Giloi, head of the Berlin branch of Gesellschaft für Mathematik und Datenverabeitung (GMD). It is funded by the German Ministry of Research and Technology (BMFT). Several research institutions and companies are involved in carrying out the work in the project: Krupp Atlas Elektronik, Stollman GmbH, GMD-First, Erlangen University, and several others.

The goal for Suprenum 1 is to produce in 1989 a 256-processing-unit system with a performance of 1-5 Gigaflops. GMD is involved in the following specific tasks:

- Development of a first prototype hardware and systems software in close co-operation with the participating companies;

- Development of specific program development environments; and

- Development of application software packages, e.g., multigrid partial differential equation solvers.

The architectural concepts were developed by Giloi and his team at GMD-Technical University of Berlin (TUB) First. Since the project is expected to result in a marketable product its performance must be obtained at competitive cost effectiveness and the program development environments must be acceptable to the users. ... (European Science Notes, 2 February 1987)

India

Indian telecommunications development

The telecommunications sector, as the structure necessary for the country's technological reorganization process, has been given special importance in the 1985-1990 five-year plan launched by the Indian Government. The latest action taken recently indicates the desire for change in this field.

In India, one of the main problems is the shortage of telephones. With only five telephones per 1,000 persons, India is better off than Burma, Bangladesh, Nepal and Bhutan, but is away behind its neighbours Sri Lanka, Malaysia and Thailand.

As regards transmission, a plan is being tested with respect to the installation of a package-communication network with nodes installed at Bombay, New Delhi and Madras. In a second stage a still more important network is to be set up with eight nodes.

The Government has set up a centre for the development of telecommunication whose goal is to reduce India's dependence on foreign countries. One of the first tasks assigned to the centre has been the conception and production of a numeric standard capable of equalling the other world numeric networks.

A team of young engineers has interested itself in this project. It has already presented a numeric PABX telephone standard whose production will take place next year. Other research teams are planned, notably in the transmission field.

The most recent action taken by the Government will make it possible for private industrialists to launch themselves in the nascent communications industry. Electronic enterprises have been created at the level of each state in order to solicit the participation of local industrialists in the projects. (Bulletin IBIPRESS, No. 105, 3 November 1986)

Italian telecom company in India

Italtel (the Iri group company which deals with telecommunications) is about to reach an agreement with the Indian Government for perfecting some projects concerning applications in the agricultural and telephonic communications sectors.

The agreement, which is expected to be signed shortly, will comprise orders amounting to US$100 million. One of the projects concerns the creation of a large data bank to collect information on the territory and natural resources using satellite transmission. The second project involves setting up digital telephonic exchanges for rural areas, even the most remote locations.

The programme for the development of digital telephony is extremely flexible because it will have to adapt itself to both the different types of use in the vast Indian countryside and the connection with the exchanges in some large urban centres set up by the French telecommunications company Alcatel.

While Italtel will make a major contribution to the execution of this plan by providing its own technology, the collaboration of local industry in this sector will also probably be called upon.

The other project in which Italtel is participating concerns the collection and transmission via satellite of data on the vast territory and natural resources of the country in order to improve the planning of agriculture and industry in this field. (Bulletin IBIPRESS, No. 119, 8 March 1986)

Teaching industrialists to read the warning signs

India's electronics industry has evolved a new-style training and technology centre intended to bring the benefits of modern instrumentation to half a million small-scale enterprises on which the nation's future prosperity may depend. Similar institutions are to be established by the educational and industrial planners of many poor countries in order to help them through an unavoidable stage of industrialization which renders vast populations vulnerable to disasters triggered by the erroneous application of high technology.

The Bombay Institute for the Design of Electrical Measuring Instruments has won international prominence since the Bhopal tragedy two years ago when a leak of poisonous gas from a pesticide plant led to the death and injury of thousands of residents of a shanty-town nearby.

The principal director of the institute, P. K. Krishnamurthi, says that "after the disaster, there has been a rush of manufacturers suddenly concerned that their instruments should be properly calibrated on a regular basis. This is where we can help industry to read potential danger signs accurately in order to avoid accidents in the future".

The institute was originally intended to enable the small, indigenous manufacturers in a host of industrial sectors to survive without recourse to expensive imported technology. It serves hundreds of companies offering help in technical training and consultancy, design, development, calibration, testing, tooling and prototype fabrication.

Its specialist training programme for industry includes some 30 courses covering such diverse spheres as digital electronics and electronic troubleshooting, process control and instrumentation and photochemical milling. In addition, the institute tailors training courses to the specific needs of individual enterprises.

This element of flexibility in specialist training, developed to answer the needs of a crucial phase in the rapid industrialization of one poor country, is to be copied shortly by other higher education institutions elsewhere in the hungry world in order to ease passage along the diverse paths of their societies towards indigenous high technology.

The United Nations Industrial Development Organization has invested some US$1.2 million in precision electronic instruments as well as teaching aids and technical advice for the Indian centre. The institute has also won much co-operation and support from universities and technical colleges in the industrialized world.

Now it is likely to become a model for similar institutions in the developing regions to be established collectively by groups of universities, industries, government departments as well as specialist United Nations organizations and outside financial donors.

There was no instrument testing consultancy service in India when the institute was first established back in 1969. Some of the larger manufacturers already had limited testing facilities for their own use. But something like 80 per cent of Indian-made process control instruments originated from the small-scale sector, and their producers urgently needed access to a reliable evaluation centre. The institute has filled the need.

Circuitry for an electronic balance, microprocessor kits and a card for testing car electrical cables are just a few of the diverse jobs that the institute has undertaken for industry. It has also lent its services to tackling one of India's major social and economic problems - population control by precision moulding of the T-shaped plastic anchor for intra-uterine contraceptive coils. (Development Business, 15 December 1986)

Japan

The Japanese supercomputer in difficulty

The programme for the development of a computer with very high-speed processing, begun in 1981 by the Japanese Government and which earmarked funds for US$140 million, is currently going through a critical period.

The project, which was planned to end in 1989, is aimed at developing, by this date, a computer with a calculation capacity one hundred to one thousand times faster than the computers now on the market. The superfast computer, whose applications should be generalized, would be able to process a capacity of 10 gigaflops or thousand million floating points a second. The research and study concerning the new technologies to be applied to the supercomputer are now organized at various levels, both for the hardware and the software, as well as the design.

The studies and experiments on one of the three new technologies to be applied to the development of superchips, which would have made possible the high processing speed needed by the supercomputer, were abandoned due to the technical difficulties encountered and the high costs. For the other two advanced technologies, research seems to be going ahead very slowly.

One of the technologies under experimentation is based on the development of the "Josephson junction", which is operable and functions at -170 degrees centigrade, with the difficulties that can be imagined of finding material that resists and functions at such temperatures. The other two new technologies concern: the development of high electron mobility transistors, which also operate at low temperatures, and gallium arsenide. (Bulletin IBIPRESS, No. 113, 15 February 1987)

Republic of Korea

Semiconductors: Made in Korea

Korea's semiconductor industry is picking up these days at a steady pace after experiencing a setback last year when chip prices hit rock bottom in international markets. According to the Ministry of Trade and Industry, Korean exports of semiconductors topped $761 million as of the end of July, up 34.6 per cent over the first seven months of last year. Local makers predict that exports will reach $1.5 billion or more for the year. This is a growth of 22 per cent over 1985.

The turnaround is welcome, obviously, particularly in view of the fact that some prices have doubled since 1985. For example, 64K-bit DRAM selling for $0.40 to $0.50 last year is going for $0.90 to $1.00 this year. The 256K-bit DRAM that now sells for $2.60 brought only a $2.00 return last year. The major contributing factor for the price rise is the joint agreement between the United States and Japan. Although Korea was not a party to the agreement, it has benefited by the resulting stabilization.

Even so, a healthy market brings in more companies that want a piece of the action which, in turn, heightens the competition. The Daewoo Electronics Company, for instance, pushed ahead with construction of a semiconductor factory in Guro Industrial Complex on the outskirts of Seoul. The initial investment was $18 million. Mass production began in November, challenging the dominance of Samsung Electronics, Goldstar Semiconductor and Hyundai.

At any rate, the industry is flexing its muscles. Last year, according to the Business Korea '86 Yearbook, the semiconductor industry accounted for 15.8 per cent of the country's total electronics production and 24.4 per cent of electronics export. Interestingly, 92 per cent of semiconductor production was exported while 73 per cent of domestic demand was supplied by imports.

The future looks bright for the Korean semiconductor industry. The Korea Institute for Economics and Technology (KIET) forecasts that the country's share of the world market will increase from 1981's 5.3 per cent to 8.8 per cent in 1990 and 11 per cent in the year 2000. This, despite the lack of raw materials, trained technicans and production capacity that is still only about half that of the United States or Japan. The size of the industry by 2000, says KIET, will be a whopping $12 billion, a figure roughly equivalent to the entire Korean electronics industry of today. Furthermore, makers will invest around $3.4 billion in R&D and another $5 billion in manufacturing facilities by 2000.

Korea has progressed a great deal already. In the 1970s, domestic makers were simply assemblers. As recently as 1985, Goldstar announced a 64K-bit SRAM and 1M-bit ROM, and Samsung introduced a 256K-bit DRAM.

If anything, semiconductor development should accelerate. Earlier this year, the Association of Korea Semiconductor Manufacturers was established with 13 domestic makers registered as members. Among these companies are Goldstar, Samsung, Hyundai, Daewoo, Anam and Poongsan. (Anam is a specialized semiconductor assembly service. Poongsan makes lead frames for semiconductors.) The Association will receive government subsidies for research and development. A focus of the organization will be to advance domestic capability in the area of semiconductors, including development of 4M-bit DRAM. (AEU, November/December 1986)

Korea Electronics Show 1986

The 17th Korea Electronics Show held at the Korea Exhibition Centre (KOEX) 8-13 October 1986 showcased some 73,500 products from 460 companies. Manufacturers from 15 countries were there - 198 of them from abroad - but the biggest news came from the Korean companies, including Samsung Electronics' 4 mm camcorder with built-in LCD TV. During the six-day show, some 200,000 visitors walked through the KOEX doors, and 5,000 or so were buyers from foreign countries.

The buyers were buying too, at an average rate of about $160 million, given the total sales contracts signed at the show. According to B. K. Yoo, director of the Electronic Industries Association of Korea (EIAK) which sponsored the show, "Last year we had 445 companies from 14 countries.

Export sales contracts during last year's show came to $790 million." He went on to say that $800 million in export sales contracts were expected at this year's show. If the target was reached, it would represent nearly one-tenth of Korea's total electronics production (not just export) during the first three quarters of the year. Production this year is up, it should be noted, by 45 per cent over last year's pace.

Just what was it about the show that it could attract such luminaries, crowds and buyers? Certainly it benefited by the high yen in relation to the dollar as overseas demand for electronics has shifted somewhat from Japan to Korea. In addition to that, Korea is emerging as a source of electronics products that are quite advanced but also reasonably priced. (AEU, November/December 1986)

Mexico

Hewlett Packard of Mexico secures exclusive production of two hp-3000

Hewlett Packard Corporation of the US has decided to transfer the exclusive production of the new hp-3000/52 and hp-3000/58 computer series to its Guadalajar production plant in Mexico. This will add the two computer models to the 37, 37XE, 42, and 48 series already being manufactured in the Mexican plant. For the first time, the development and production of the 52 and 58 series will take place outside the home country of the corporation. Sales of the two new series, 90 per cent of which will be sold in the US and Japan, will benefit the Mexican economy. It is expected that tens of millions of dollars worth of the computers will be exported annually.

The decision to transfer the production of the hp-3000/52 and hp-3000/58 series was sought by the Hewlett Packard operation in Mexico. The Mexicans based their argument on the Escuincle printed circuit, which is patented by the research and development division of the Guadalajara plant. This printed circuit was one of the first memory products based on 256-k bit chips to appear on the market. In the hp-3000 model, the circuit has six layers, 2 mbytes of memory, and can be used as the central memory of the system. For more than a year, almost all hp-3000 series computers have relied on the Escuincle circuit. This was the decisive factor in the decision to transfer production of the hp-3000/52 and hp-3000/58 to the Guadalajara plant, which controlled the patent. (Bulletin IBIPRESS, No. 115, 8 February 1987)

Peru

Software and equipment made in Peru

TCC, Telecommunicaciones, Computacion y Control S.A., a Peruvian company, has been developing software products in Spanish for the Latin American market. It has already produced programs for applications in payroll accounting, stock-inventory control, general accounting, and budget and cost-accounting for civil construction and engineering projects. Likewise, TCC has been developing and manufacturing auxiliary and expansion products which can be used on Cromenco microcomputers available on the Mexican market.

The central rapid readout system, which is designed for the telephone company of Peru S.A., is an example. The system offers a rapid disk-readout capability and can be run from a Cromenco 3102 terminal. TCC has developed interfaces for the Cromenco CS3 microcomputer for disk-readout and data-transmission using IOP and Quadart, a star-configured network.

Another product is the computer-based vote-tabulation system. It can be linked to 256 voting sources and is therefore ideal for government congressional bodies, such as the senate and chamber of deputies of Peru, or medium-sized associations or groups.

A third product is the magnetic and alphanumeric-character printing system, which is likewise designed for the Cromenco microcomputer.

Finally, the company produces a data concentrator designed by Entel Peru, a national telephone-communications enterprise. The concentrator is used to collect the data which have been transmitted or received from the remote, or PBX, stations linked via modems to the Entel centre. This product is also run on the CS3 microcomputer. (Bulletin IBIPRESS, No. 118, 1 March 1987)

Singapore

Singapore to become centre for sophisticated software

The Asian island State of Singapore, which enjoyed rapid advances in prosperity until the early 1980s, now faces an unprecedented slump. Many of the manufactured goods which fuelled that growth are now made more cheaply in poorer Asian countries. Singapore's output fell 1.8 per cent last year and could fall another 1.5 per cent this year.

In an effort to reverse this trend, the Government is directing a concerted drive "upmarket". Singapore aims to become a major world centre for producing sophisticated software.

Lim Swee Say, deputy general manager of the National Computer Board (NCB), says: "Last year was a tough year for the information technology industry in Singapore. While the total revenues went up $216 million in 1984 to $256 million in 1985 the growth rate has slowed down from 29 per cent in 1984 to 16 per cent in 1985.

Much more significantly the growth in production of hardware has fallen still more sharply, while software sales remain buoyant. Last year Singapore's sales of software and services increased 28 per cent to $75 million compared to 1984, although this was mostly due to strong home demand. In contrast sales of hardware increased just 14 per cent to $180 million.

The slowdown of computer hardware sales was especially marked in Singapore. In 1984 demand for computers was extremely strong compared to the previous year - up 47 per cent for microcomputers and 27 per cent for minicomputers. Last year the home market registered just 6 per cent growth for all segments of the market.

In export terms, Singapore is more important so far as a manufacturer of hardware than as a producer of software. Last year 83 per cent of Singapore's total exports of information technology products and services worth $57 million came from hardware.

One key component of the Government's efforts is an information technology institute opened in April under the directorship of Lim Swee Say. The institute has its roots in an applied research programme primarily run jointly by the NCB and the Systems and Computer Organization of Singapore's Ministry of Defence which started in August 1983.

Initially the institute's programme will focus on three major areas: software engineering, knowledge systems and integrated office systems. In the area of software engineering the institute is aiming to develop a computer-aided environment for software developers. It will sponsor applied research to produce system development methodologies and software tools to help software authors boost productivity and efficiency.

In knowledge systems the institute is particularly keen to establish Singapore's capability at the "leading edge" of information technology. Lim explains: "The trend is from data processing to information processing. Singapore has identified artificial intellegence and expert systems as a crucial growth area."

The institute has already bought one artificial intelligence workstation and will gradually purchase more equipment and develop its techniques. At first the programme will emphasize application development to gain expertise to build knowledge systems. Subsequently it aims to develop tools to build them and design natural language interfaces. (Computing, 2 October 1986)

South-East Asia

Electronics in South-East Asia: struggling but poised for take-off

The Electronic Industries Association of Japan (EIAJ) has conducted an annual survey of the electronics industry in South-East Asia. The survey this time included Korea, Taiwan, Singapore and Hong Kong, the four leading countries. In the midst of the severe economic situation resulting from the sharply appreciated yen, new industrial countries (NICs) are experiencing hardship.

In general, last year's growth rate was down from the year before as shown in the following (growth rate of 1984 shown in parentheses): Korea, 5.1 per cent (7.6); Taiwan, 4.7 per cent (10.9); Singapore, 1.8 per cent decrease (8.2); Hong Kong, 0.8 per cent (9.6). On the other hand, foreign currency reserves are steadily increasing. Taiwan's reserve has exceeded US$20 billion and is estimated to reach $30 billion by the end of this year. A large export surplus may bring trade friction.

Korea has the highest level of production and the other three countries have been at a higher level lately but showing a tendency to levelling off.

The Korean economy has shown signs of increased activity in general because of the Seoul Olympic Games which will be held two years hence. The appreciation of the yen has also given some advantages to the won regarding Korean exports. Taking this opportunity, Korea is promoting the exports of every industry. In the electronic industry, in particular, the drive is to promote the export of finished units and electronic parts.

Japan-Korea trade is still in Japan's favour. The Korean import of electronic parts, for example increased by 50 per cent compared to last September. In this regard, the EIAJ report notes: "The tendency means that they consider changing their policy not only to disconnect themselves from Japan and promote the domestic production of material parts but also to depend more on Europe and America than on Japan."

It seems, however, that as for certain key parts, Korea still must rely on Japan. The appreciation in yen has led to an increase in import unit cost of production materials required for the manufacture of sets such as plastic, paint, chemicals, wires, steel materials and machinery.

The makers of both sets and parts do not appear to be making profits in proportion to the great volume of business. The employment environment is favourable, however. It is reported that in the electronic parts manufacturing industry, most workers are under a two-shift and 24-hour system to increase output, and some others under such stiff working conditions as 28-days-a-month without a day off. The wage base in the Korean electronic industry is about one-fourth that of Japan's at present.

The production of colour TVs, VCRs, radiocassettes, car stereo, personal computers and microwave ovens has been increased not only by local leading makers but also by small and medium-sized makers receiving orders from Japan for OEM. It appears that the favourable situation will remain throughout next year at least. However, since key parts are not available locally, makers must rely on Japanese makers, and in fact, they have to continue to use them, even if highly priced. The capacity to produce parts cannot be greatly increased. Under such circumstances, parts makers have given priority to local delivery rather than sending parts to Japan.

About 400,000 VCRs were manufactured in June 1986 by four companies, including Samsung Electronic Co., Goldstar Co., Daewoo Corporation and KTT. This figure is 2.5 times that in June 1985. They will manufacture 3.5 million units for the year, taking delivery of key parts from Japan. The production of colour TV by all makers totals about 600,000 sets as of June. Throughout the year, 7.0 million sets are expected to be produced. This is an increase of 50 per cent over the previous year. This is half the Japanese production and it is pointed out that, with the appreciation in yen, the shift from Japan to Korea is now clearly seen. The report says that Japanese key parts, such as electronic tuners and SAW filters influence the production limits.

The production of radiocassette recorders and car stereo has been greatly increased due to the shift from Japan. In addition, the production of telephone units has been favourable. Korea is now the second largest producer of microwave ovens, following Japan. The production of information units including personal computers has also been quite active.

Among Korean parts makers affiliated with Japanese makers, orders received are 60 per cent higher this year. This situation is estimated to continue up to the first quarter of next year. Local makers are now expanding their own parts plants.

The Government intends to foster small and medium-sized makers by advancing funds of every kind to them. Taking a leading role in promoting the national production of electronic parts, the Commerce-Industry Division made it public at the beginning of this year to start manufacturing 500 items of high-tech parts domestically, which now greatly rely on Japan.

Korea has been linked with Japan so far, particularly in the electronic industry, and it appears that the time has come for Korea to consider which products and parts are most suitable for them.

Singapore economy is forecast to show negative growth in 1986 the second year in a row, affected by declining international competitive power due to the high wage policy in the past, sluggish petroleum prices and domestic public investments which have generally been completed. As a result, the Government is compelled to revise its policy to cope with slack business activities including freezing of wages enforced in April this year and reduction in corporate tax. The Singapore economy is really in transition.

Recently, insufficient labour mainly in the electronic industry pushed the Government to ease regulations on the influx of workers from neighbouring countries. The depression in 1985 turned upward after reaching the bottom in November/December, and production shows rapid expansion since March because of the strong yen. The shift is expected to be accelerated further, reaching a peak in the period of July-September. Then the pace of production may slack off in view of the uncertain future including trade with the US and problems of set makers including procurement of parts.

Despite GE's withdrawal, colour TV sales are very active and are expected to renew the record sales of 3.9 million sets in 1984 due to an increase in production by Japanese affiliated makers. The most serious bottleneck for the production increase of colour TV is the unstable supply of key parts such as cathode-ray tubes. Singapore is an audio products exporting base to Europe and America, mainly radiocassette recorders and car stereo. Many Japanese-affiliated set makers engage in production there.

Competition from other NICs

Production has marked a new high record, but the price competition in the US, the largest market, is intensifying, and NICs countries are edging in on Singapore. Therefore, the vertical diversion of work will be carried out more strongly according to product rank. For instance, production of general tape recorder will be handled by Malaysia and that of stereo radiocassettes by Singapore. The computer industry in Singapore has many branch plants of US-affiliated makers under the system of international division of labour. As for peripherals, production of disk drives account for 20 per cent of the world demand, being produced by Western-affiliated makers with the characteristically high share of HDD. There is a strong possibility that the telephone market will become stable in the future in view of AT&T's production.

The capital advancement by Japanese-affiliated makers is active, and they are increasing production. Even so order backlog surpasses their production capacity. However, Singapore's basic structure of materials acquisition is behind other NICs and the supply of materials is directly or indirectly dependent on Japan. The higher cost of materials due to the strong yen has had an adverse effect on earnings. Parts companies are pushing price raise negotiations.

Only the electronics industry shows healthy growth under the general economic forecast of negative growth, supported by the economic recovery in the US and the shift by set makers, mainly Japanese-affiliated companies. From a medium-range viewpoint, however, the outlook is not necessarily all bright for the following reasons: (1) The household equipment market is being captured by Korea and South-East Asia, and the development of high added-value products has its limits in view of the relationship with Japan. (2) Industrial machines and equipment have been developed to grow as a non-labour-intensive industry, but the industry's foundation is not solid yet. It does, however, show activity in the fields of IC, personal computers and peripherals. (3) The ratio of exports is high, and the industry is highly dependent on the US market. Uncertain factors remain depending on the business situation of the US.

Despite such uncertain elements, Singapore is most politically and economically stable among NICs for Western and Japanese-affiliated makers, with the most generous regulations on investments. Some makers regard Singapore as a parts purchasing base. Its role as a free port is very important. Singapore will increasingly play the role of a branch plant for US and Japan as an administration base for Malaysia and neighbouring developing countries.

The economic growth of Hong Kong in 1985 posted real growth of 0.8 per cent after repeated downward revision of GDP from the initial 7.9 per cent because of the decline in exports across the board to the US and China, the two largest export markets, as well as to England, West Germany and Canada. The Government's 1986 outlook for economic growth is a nominal 9.0 per cent, and real 4.5 per cent.

In 1985, Hong Kong experienced violent changes. In the latter half, especially, the trade inventories in the US, the main market, increased. Also the effect of export regulations became noticeable due to the enforcement of stronger foreign currency administration in China in March, causing a slowdown in re-export to China. The outlook for 1986 is a 10-15 per cent increase in local exports in view of the negative growth in 1985 and the weak dollar. A considerable quantity of products from Korea, Taiwan and Singapore due to the strong yen came into Hong Kong. The recent movement of radiocassette players is inactive: a decrease of 26 per cent compared with last year, the worst market condition ever experienced.

Regarding colour TV, companies have aggressive plans and sales are expected to show remarkable growth for the US and Europe taking advantage of the favourable position against Japanese-affiliated companies due to the higher yen. They depend, as do other NICs, on Japanese-affiliated makers for key parts. There is a sign of an increase in production of telephone sets mainly by large makers prompted by the inventory adjustment in the US market. The movements of AT&T and Uniden are worth notice. Recent activities are centred on exclusive telephone set makers, and the shift from one-piece to high added-value sets and PBX production has just started. However, prices are continuously coming down.

Concerning the production shift from Japan due to the strong yen, there are few production bases of Japanese-affiliated companies in Hong Kong as compared with Korea, Taiwan and Singapore, and no rapid increase is expected in view of the labour force, labour capability, wages and political background. Exports and imports to and from Korea, Taiwan and Singapore will make no big changes with only small orders for OEM. Acceptance of orders for electronic parts is active since April and will continue current conditions to the end of the year when it will decline somewhat. The price trends of electronic parts have already incorporated a mark-up of 7.5-20 per cent considering the appreciating yen.

Hong Kong has been prosperous as a processing trade base and transit trade base in addition to the finance and information communication base of South-East Asia. Also, it has played the role as a leading indicator of the business situation as the contact point for trade with China. In the recent business situation, Hong Kong seems to have gotten behind other NICs in other areas such as production. Hong Kong tends to produce electric calculators, watches, and toys, which do not have a great influence on business situations. It turned to the production of lowest electronics for China in 1983 and lost ground to Taiwan and Korea technically. Japanese-affiliated companies have made little advancement into Hong Kong, due to the strong yen.

As for the future course and problems of Hong Kong, its key industry will be tertiary, mainly financing services, and there will be no change in the ratio of the processing industry such as electronic and textile even in the future. The bases for this outlook are continuously strong demand for low-price products and a favourable position in utilizing the inexpensive labour force of China in addition to its local processing power as industrial foundation. In conclusion, the future course of the electronic industry of Hong Kong depends on the political and economic movements in China and its effects on the electronics industry. (AEU, November/December 1986)

United Kingdom

UK unveils regional technology centre plans

Education Secretary Kenneth Baker has announced plans for a new network of regional technology centres. These centres would bring together colleges, polytechnics and universities to work with firms to keep up to date and disseminate Information Technology course data. The centres - Baker hopes for nine in the first year - will also provide a consultancy service for the implementations of new technology and training of employees.

The Government will give each centre £100,000 for the first year with a scaling down of finance over the next two years. However, Baker stressed the need for the centres to be self-financing after this period.

The centres will be an extension of the Department of Education and Science's Professional, Industrial and Commercial Updating scheme (PICKUP). The idea of PICKUP is to provide vocational skills for those in employment. As with the new centres, the consumer pays.

Baker said that some three million student hours had already been taught under the scheme and that the leading 38 colleges concerned had turned over some £10 million.

Baker talked of other PICKUP initiatives being considered including creating a network of language export centres offering foreign language training coupled with background information about the countries concerned.

He said he wanted to see trade union involvement in PICKUP and wanted to encourage the development of technology transfer by means of tutored video instruction. (Electronics Weekly, 3 December 1986, p.33)

Alvey backs "largest" CAD project

The largest project for computer-aided design which the UK Government has ever funded - and the last one that will be funded under Alvey - is shortly to be announced.

According to Derek Boardman, the CAD boss at Plessey's Caswell research labs, a total of £6million will be spent by Alvey plus Plessey, Ferranti, Racal, STC, RSRE, GEC, ICL and Praxis.

The aim will be to produce a CAD system sufficiently powerful to design with the 250,000-gate custom and semi-custom chips which Plessey Semiconductor will shortly be capable of manufacturing via its four level metal and trench isolation technologies.

Boardman explained: "Our one-micron process will handle 250,000 gates but current CAD systems can only design 300 gates per man/week. At that rate it would take 16 years to design a 250,000-gate chip. To exploit our process technology the CAD systems must be enhanced."

Accordingly, the new Alvey project will be aimed: "at producing a CAD system capable of designing 10,000 gates per man/week. So allowing a 250,000-gate chip to be designed in six months." The target date for having such a system in place is 1989.

1989 is the date when Plessey expects to "swing into production" its one-micron, four-level metal, trench isolation semiconductor process which will allow it to manufacture 250,000-gate devices. (Electronics Weekly, 28 January 1987)

Multidisciplinary centre for electronics

A new multidisciplinary Centre for Electronic Materials was formally opened in Manchester last week.

It is based at the University of Manchester Institute of Science and Technology (UMIST) and is funded by the Science and Engineering Research Council (SERC), the Department of Trade and Industry, UMIST and with money from industry. It will have a £2 million budget, rising to £3 million in its second year. The centre is set up as a co-operative effort by five university departments. It will have academics and students from the fields of chemistry, electrical engineering and electronics, instrumentation and analysis, material science and corrosion science.

The centre's staff say their aim is to "investigate the unresolved problems of today's material and to explore the next generation of electronic devices". It will run a new Master of Science course in its subject area, as well as special short courses for industry. Opening the centre, Bill Mitchell, chairman of the SERC, said that Britain's universities, polytechnics and the SERC had to change their approach to electronics. The subject needed multidisciplinary research. (New Scientist, 2 October 1986, p. 29)

Microelectronics in small industry

The UK Government is not doing enough to encourage small companies in Britain to use microelectronics in their products and production processes, says a report* published recently.

The report, by the Policy Studies Institute in London, examines the effects of a scheme, now in its eighth year, to provide advice to firms on how microelectronics can help their businesses.

One of the main problems, the institute says, is that many companies, particularly small businesses, are not aware the scheme exists.

The scheme, which began life as MAPCON, is now known as Microelectronics Consultancy Support. This change in name has itself caused confusion.

About £10 million has been spent on MAPCON since its inception in 1978, with more than 4,000 companies taking grants of up to £3,000 to pay for advice from industry consultants. Just over half of the companies receiving these grants have acted upon the advice they were given. Of these, more than half now have a product or process using microelectronics in production.

Another 13 per cent of the companies surveyed are planning to develop products or processes with the help of microelectronics. The institute says that applications are falling off dramatically. The decline began with cutbacks to the budget of the programme, says the report's author, Jim Northcott. Up to August 1984, companies could claim the full cost of seeking advice up to a ceiling of £3,000, he says. Now they have to pay £500 of the costs of the consultancy.

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* Promoting innovation 2: Microelectronics Consultancy Support, Policy Studies Institute, 100 Park Village, London NW1 3SR. Price £19.95.

At about the same time, he says, the Government introduced a moratorium on funds from another scheme to develop industrial microelectronics. Although this did not affect MAPCON directly, it led to a general loss in confidence.

Few companies saw any point in using MAPCON when prospects for grants to carry out the consultants' recommendations looked grim.

"There would therefore seem to be a case for stepping up the publicity for MAPCON so as to reach the remaining non-user firms", the report says. The institute also believes that the present scheme, which covers studies based on 10 to 15 days of a consultant's time, is not enough for large, complex applications. Some companies who used the scheme, the institute's report says, were disappointed with the work of their consultant. One firm said that the "skimpy" report from the consultant only regurgitated the company's own description of its problem.

The Policy Studies Institute says that the Department of Trade and Industry should do more to improve awareness of the scheme. The department should also make it clear that consultants on its lists are not necessarily recommended.

The institute says that the microelectronics programme is a useful catalyst for innovation, with nearly all firms that participate saying they would recommend the scheme to others.

Almost all studies recommended the use of microelectronics, although only 54 per cent of respondents followed this advice.

The Policy Studies Institute compared the performance of companies that had MAPCON grants with those that did not. Some 30 per cent of firms which had MAPCON feasibility studies had microelectronics applications in place at the time of the survey, compared with 16 per cent who were considering new technology, but had not employed consultants under the MAPCON scheme. (This first appeared in New Scientist, London, 4 December 1986, p. 20, the weekly review of science and technology)

Computer scientists put their brains together

Scientists from a wide range of disciplines at University College, London, are joining forces to work on future generations of "intelligent" computers. Similar teams have already been set up in Japan and the US, but the idea is new to Europe. The aim is to bring together experts in neural science, psychology, biotechnology, physics, chemistry and computer science, all of whom have overlapping interests in advanced computers or in how the brain works.

Philip Treleaven, who is organizing the multidisciplinary steering group at UCL, believes that the next generation of intelligent machines will provide a fundamental breakthrough in computer technology. The machines will emulate the way the brain works. They will probably be based on optics and molecular structures, rather than traditional materials such as silicon and gallium arsenide.

The UCL group should stir some interest in the organizers of the EEC's initiative in information technology, Esprit. Esprit II, when it happens, will, for the first time, provide money for "blue sky" projects of this kind. The current Esprit programme takes no allowance for very long-term projects.

Treleaven believes that there are two basic domains in computing. One is characterised by existing machines that work by manipulating symbols. This method is good at laborious calculations. The other is characterised by things the human brain is good at, such as recognizing voices and images. The capability for general pattern recognition is Treleaven's goal. "The real revolution in computing will come when we make the leap from one domain to the other. That hasn't been done, and it will need a fundamental convergence of experts in all areas," he said.

Treleaven feels that today's so-called intelligent computers, or expert systems, have proved less of a breakthrough than originally expected because they simply regurgitate knowledge fed into them. They hold a human's expert knowledge in order to enable them to answer questions. Future intelligent machines will learn new knowledge and recognise patterns.

The current round of research into advanced computers (such as the Alvey programme in Britain, Europe's Esprit and the Japanese fifth generaton programme), use an approach based on symbol manipulation. Knowledge is a collection assertions represented by formal symbols, and thinking is the process of making deductions by manipulating these symbols. Future brainlike computers, said Treleaven, may centre on connectionism, which models the connections of brain cells. Here, thinking involves the computer trying out different connections in a network of artificial brain-cells until it settles on one that calculates the right answer.

Who will fund these "sixth generation" computers? Treleaven fears that the Science and Engineering Research Council will not be able to cope with the interdisciplinary nature of the work. Each of its subject boards may feel that it is in another's territory. (This first appeared in New Scientist, London, 18 December 1986, the weekly review of science and technology)

Hardware R&D plea to government

Recommendations to spend more than £250 million on hardware research have gone before the Government.

The proposals, part of the report of the IT '86 Committee chaired by Sir Austin Bide, also said that future UK semiconductor work should concentrate on application-specific integrated circuits (ASICs) and that highly collaborative programmes centred around one or two up-to-date facilities would be necessary.

Although the recommendations deal mainly with CMOS and bipolar technologies, the committee added that it urges the creation of a UK gallium arsenide foundry to be set up with Department of Trade and Industry support as an endorsement to the current DTI/industry efforts to map out a three-year GaAs strategy.

The report went on to say that the national ASIC focused work would be in addition to UK input to parallel pan-European programmes such as Eureka and Esprit.

The figure of £250 million is the lion's share of a suggested £550 million IT research programme, with £300 million coming from the Government. Other priority suggestions include £25 million for human interface work, £200 million for systems and software, and £75 million for demonstrator projects.

It is important to note that the £550 million includes the UK input to the second phase of the Esprit programme. The Government, the committee said, is expected to contribute about £135 million to the research part of Esprit II, leaving just slightly more than half for the UK national research effort.

The research effort is intended to run in conjunction with a £500 million applications-oriented scheme, based on technology pull-through projects carried out by collaborative user/supplier teams. The government input here would be less - £125 million with the funding per project depending on the risk involved - and is intended as an incentive for industry "to make such risky collaborative work a priority in their own business plans".

The committee has suggested eight specimen projects, all of which use technology developed under Alvey or Esprit, but stresses that other technolgies may be used where necessary and available.

Other major points of the report are the need for more attention and respect to be paid to the idea of training, and on the need for greater communications. (Electronics Weekly, 26 November 1986)

Carbon chips initiative

A multi-million pound initiative aimed at developing a new generation of electronic components made from carbon-based compounds was launched by the Science and Engineering Research Council (SERC).

Proposers of the initiative have asked for £30 million funding spread over five years from the SERC, the Department of Trade and Industry and electronic companies.

The aim of the initiative is to carry out pre-competitive collaborative research between electronics companies and British universities to develop electronic components which mimic some of the biological processes that occur in living organisms. These components are to be called molecular electronic components.

Key areas of development include liquid crystals, Langmuir-Blodgitt films, organic conductors, non-linear optical materials and sensors.

The ultimate goal of the initiative is to develop a computer whose workings would be closer to that of a human brain than any existing computer. (Electronics Weekly, 4 February 1987)

Zimbabwe

Computer industry comes on key

Rationalization will be the watchword for the Zimbabwean computer industry for the next five years or so. The total Zimbabwean market is incapable of absorbing all Zimbabwe's hardware manufacturers, currently numbering 20, although demand far exceeds supply.

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

A substantial body of opinion in the industry believes it will simply not make commercial sense for some manufacturers to push their Zimbabwe operation because the market is already overtraded. One reason for the large number of vendors was that the market was wide open at independence, after 15 years of sanctions when whatever came into the country came in the back door. That there should be some settling down seems plausible. (Asia-Pacific Tech Monitor, September/October 1986)

GOVERNMENT POLICIES

Yugoslavia

Microelectronics development in Yugoslavia

After three years of preparatory work, an elaborate programme has been put forth by a team of experts who met in Opatija (14-16 May 1986) with a budget of 1.737 million dollars over eight years.

The Fifth Yugoslav Conference on microcomputers in process control had as its central topic the project of the development of microelectronics in Yugoslavia. The preparatory work has taken three years. In the preliminary phase a number of competent experts from all republics worked upon a complex study on our "backwardness" in the field - from which, later on, resulted operative schemes for doing away with it.

In Yugoslavia there are as yet several producers of microelectronic components, among them Iskra, Ei, RIZ, and Rudi Čajavec; but there has been no strong, vertically connected electronic complex that would include producers of microelectronic components - together with those of equipment, telecommunication systems, automations and robots, professional information equipment etc. All of the above-mentioned have so far been developing in a rather unco-ordinated, autarchic way.

The Opatija Project - as it is referred to - follows the global strategy of long-term technological development of Yugoslavia, offering a systematic approach with priorities.

Now let us focus on the programme itself. It is divided into two parts: semi-conductors and hybrids. Part I is further on subdivided into the production of specific materials, dicrete semiconductor elements, linear and digital microelectronic units, project-making and production of masks, specific equipment, and - last but not least - quality and reliability. The realization of the programme as a whole should take eight years, with investments valued at 880 million dollars (at now valid prices). Considered separately, the infrastructure's worth is 410 million dollars. Next, the hybrid programme includes materials, components, the development of technology and equipment. All, again, in eight years. Worth: 175 million dollars (infrastructure alone 60 million dollars). A special emphasis is to be laid on science and education. The centres of these activities have, reasonably enough, been placed at universities, R and D departments, and research institutes. Investments here amount to 152 million dollars.

Another basic macro-project entitled "Microelectronic technology" has been proposed for realization in an eight-year period, worth 60 million dollars.

Prof. Dr. Petar Biljanović from the Institute of Electronics in Zagreb states - in his final report on the project - the sum total to be invested in the complex production-science-education: 1.737 million dollars!

Now it is up to the newly elected Yugoslav Government to give full support to the realization of this highly ambitious, yet inevitable project that will lead Yugoslav society into the information era. At the same time, it is meant to help enable its economy to participate in international competition, beginning with Eureca.

Josef Stefan Institute - Research in the field of microcomputer application

The Josef Stefan Institute operates within the Edvard Kardelj University of Ljubljana as an independant research organization. The Institute developed from the former Physical Institute of the Slovenian Academy of Science and Art, founded in 1949. From 1955 on, the Institute worked within the framework of the Federal Commission for Nuclear Energy and in 1962, it became an independent research organization. In 1986, there were 750 people employed at the Institute; 420 have university degrees among which there are 140 Doctors of Science.

The Institute covers in its research the field of natural sciences, technical and similar disciplines. ...

The Josef Stefan Institute has developed numerous activities based on microcomputers used for control and supervision of industrial processes in medicine and ecology. Computer science developed at home or transfered from abroad was applied through research projects. Let us mention just a few of them:

Automation group deals with research, development and application of computer automation. The objective of this activity is widening and deepening knowledge in the field of theory of system control and application of this knowledge in practice. Such objectives demand a co-ordinated development of knowledge in the field of theoretical and experimental studies, demands the development of modern, computer-aided tools for CAD and relevant hardware and software. All these elements connected with engineering and technology provide a successful implementation of applications.

Applications are divided into two domains. The first comprehends analyses, studies and preliminary designs and the second development of computer-aided produc.. Within the first, the Preliminary project for automation of highbay cranes by microcomputers was elaborated. In this project figure the basis for development of our own system for automation of highbay cranes based on the use of the system of interconnected computers.

A quite lengthy work was performed in the field of computer automation in production of cellulose. The research comprises the analyses of the technological system and the preliminary project for cellulose cooking by computer automation.

Within development of computer-aided products we should mention the microcomputer regulator of combustion.

The idea was to make a microcomputer regulator of combustion that would be used in industry furnaces and will allow for a better combustion, save energy and pollute less the environment.

Biocybernetics group researchers in the following domains:

- Functional electrical stimulation of extremities;
- Development of measurement instruments and evaluation methods;
- Co-operation with TGO Gorenje in the field of medical electronics;
- Implantable systems;
- Electrical stimulation of urinary system.

The microcomputer stimulator was tried clinically and it stimulates in a certain order six muscle groups. It is now used for stimulation of the affected leg in hemiplegic patients. In the field of implantible systems the stress was layed on minimization of electronic circuits for an independent implantable stimulator. The entire circuit with 17 integrated circuits is in a 25 . 25 mm^2 housing. The stimulator has its own energy and when implanted operates without outside electronic control. Minimization is executed in thinlayer hybrid technology.

Robotics laboratory performs basic research in the field of mathematic modelling, dynamic control and adjustment of manipulation robots. R&D is also performed on industry robots and their application in industrial manufacturing processes. Based on basic research and simulations, several experiments were performed on GORO 101S and GORO 80 robots, developed in our laboratory. A laboratory robotized production cell with two robots, controlled by a special programme language, was made.

An important activity of this laboratory was applied research and development of industry robots in the past year. An industry robot GORO 102 for surface protection was installed on the production line for enamelling of cookers in the Gorenje factory. This is the first application of industry GORO 102 robot, developed at the Josef Stefan Institute and manufactured today on an industrial scale by Gorenje.

Artificial intelligence. The research programme of methodology and application of artificial intelligence comprehends the following fields:

- Techniques, methods and tools of artificial intelligence;
- Development of expert system for diagnostics and treatment of disturbances in heart pace;
- Computer understanding of natural language;
- Development of expert system assisting the daily keeping of bank liquidity; and
- Intelligent sensor systems.

Planning of microcomputer systems. The most interesting results in the field of microcomputers is development of the first Yugoslav 16-bit single card microcomputer for general use. Its total programme compatibility with Iskra-Delta computers and DEC, family PDP-11, with RT-11 operating system and quite low production costs due to use of very condensed circuits has ensured popularity among professional users especially in the R&D milieu.

Information systems. In research studies on participation methods of decision-making the problem of aggregated explanation of decisions and mechanisms of seeking optimum variants were treated. Beside the theory of multi-parameter decision-making based on logical rules the link between support systems for decision-making and classical expert systems from the field of artificial intelligence was studied. This problem was especially dealt with from the aspect of gaining expert knowledge in decisive situations.

Computer communications and networks. We have developed software for subscribers' modules of the Iskra's microcomputer-controlled SI2000 telephone exchange.

Computer graphics and planning in electronics. We have finished the development and implementation of the GKS standard up to the level o.b on the VAX-11 computer. Thus, we have developed a general tool for development of graphics applicative packages, namely for research and development of software for CAD of circuits. We have developed the graphic interface for the DEC LS-120 printer. In the field of development of CAD of printed circuits our own prototype of automatic connector was completed by heuristic methods of studies of graphs, thus becoming comparable to foreign ones.

Laboratory of energetics and process control covers an interdisciplinary field of work. Technical problems of energy and control of processes are dealt with, especially the cross-section of the two fields, i.e. control of energy processes and systems. Basic research, development research as well as follow-up of results until final application are performed.

The most comprehensive work is performed on automation of internal energy systems, mostly in industry and by use of computers. A very typical example of how to optimize the operation of internal energy systems in elimination of peak consumption of energy: on automatic levelling of electrical power consumption by switching off less important loads, or by switching on one's own sources of electrical energy.

Important savings can be achieved by optimal management of an internal system of heat-supply. Our industry could save up to 10-20 per cent in its present state.

Automatic measuring systems for experiments, systems for energy conservation, systems for machine and process automation in industry were made on the basis of composition of microcomputer elements into the system called mikro-m. This composable microcomputer can be used in automation of different processes and it is used for automation of machine-tools, control and data collecting of process systems.

The universal digital programmer (UDP), also composed of mikro-m modules, can be programmed with a simple programme language in order to control machines or production lines.

Ecology. The ecologic/meteorologic station equipped with sensors and microcomputers is widely used. In a quick and reliable way it follows the movement of air, temperature, humidity, insolation, quantity of poisonous gases and detects radioactivity in the environment. Such stations are integrated in the Slovenian meteorologic network and serve also in air traffic at airports.

In the field of professional electronics researchers are specially interested in development of generators of inductive radiation used for annealing and forging of thin metal sections demanding an increased frequency of mid-frequency generators. Generators of 100 kW rated power, frequency 10,000 Hz, are constructed; this means that limits due to modern strong tyristors, converting electrical power to higher frequencies, are reached. With the development of smaller transistor generators of a few kW and supersound frequency needs of smaller users are met. Several mid-frequency generators for melting and casting of gold and silver, power 20 to 50 kW, were manufactured for a client from the Federal Republic of Germany. (Echo, Ljubljana, September 1986, pp. 17/18)

APPLICATIONS

CNC increases press efficiency

The first CNC Swiss-made fineblanking press to be placed in production in the US has been installed by Feintool AG at its facility near Cincinnati, Ohio, USA. While computer numerical control (CNC) is not new in controlling the operation of most machine tools, the application of CNC to fineblanking presses is a significant advance.

Fineblanking is a process closely associated with conventional stamping in the forming of metal parts used in a variety of products including parts for watches and surgical instruments. A relatively recent development, fineblanking departs from conventional stamping in that parts are formed to close dimensional tolerances, eliminating, in most cases, subsequent machining operations. By producing an assembly-ready part in a single operation, significant cost savings and improved part quality are achieved.

With the advent of CNC to fineblanking, economic and productivity gains are further enhanced. For example, the time required to change over from the production of one part to another is drastically reduced to a matter of minutes. Shorter run, batch lot fineblanking production is now feasible. The interactive CNC system accepts initial data through digital keyboard input for press operating functions as well as individual tool, material and part data. The system stores the data for up to 242 tools, automatically sets travels from input distance control points, calculates and sets speeds and pressures, then on command displays the data by individual page selection.

For example, page one displays the entire list of tools complete with their datasets. Subsequent pages display ram measurement, ram velocities, pressures, etc. and vee-ring/counterholder data. Material feed information, calculated production data and machine faults complete with diagnostics are also individually displayed. The system not only calculates, regulates and monitors, it also performs plausibility checks on the input data and reports unacceptable information. Once in production, the control guarantees optimum performance by readjusting speeds and pressures to compensate for variations in operating conditions.

In addition to optimizing performance and, as a consequence, consistency of production output, the control system significantly reduces the time required to achieve full production after a tool change. Stored data for the new tool is recalled with all previous operating information re-established. Only minor manual intervention is required including the actual tool and material change.

As the operator is not required to make manual adjustments for the next production rerun, the potential hazards from human error are virtually eliminated. In a matter of seconds, the control system resets and monitors the machine operating conditions increasing the safety and protection of the operator, the equipment and the tooling. ... (Industrial World, September 1986, p.11)

Plastic moulding monitored by microcomputer

A new concept in simplified computer monitoring of moulding machines has been introduced by an Irish computer software company. The system constantly monitors from 1 to 16 machines and gives instant data on production, cycle times, downtime, efficiency, materials required and expected batch completion data and time. Printed reports are issued automatically at the end of each 8-hour shift. An easy-to-read, full colour display on the computer screen shows the exact and up-to-the-minute situation in respect of each and all the machines and each of the jobs being processed.

The system was designed with the cost conscious manager in mind and apart from installation costs, which vary depending on the number of machines and physical environment, the whole system is expected to cost around £3,500 which puts it well within the reach of most moulding companies in Ireland. The company is MicronEarth Teo, Furbo, Co. Galway and their Dublin-based sales agents are MPA Systems, 75 South Circular Road, Dublin 8. Tel: 533422. (Technology Ireland, December 1986)

Lathe 'cells': A success story

Duriron is a US company based in Dayton, Ohio that makes pumps and valves for the process chemical, petroleum, and mining industries. The company is also in the business of spare-parts replacement for its customers.

In that latter capacity, the firm was seeing a lot of competition emerge in the marketplace from what are known as "parts replicators". In particular, the competition for shaft parts was substantial enough for Duriron to look for a way to improve the productivity, and therefore the competitiveness, of that particular profit center. They decided that the only way to increase their competitive edge, and to be able to maintain it, was to thoroughly modernize their production equipment with the latest technology and manufacturing strategy available. That meant, to them, the installation of two machining cells, one for turning and one for grinding, in order to produce their shafts more efficiently. The Dayton firm employs some 900 workers, 300 of them in the machine shop and another 600 in the foundry. Duriron, in fact, started up at the turn of the century strictly as a foundry operation.

The plant machines a variety of materials. Most of the wetted parts (rear covers, impellers, etc.) are high-strength materials like stainless, Hastelloy, titanium, Inconel, and other corrosion-resistant materials. Parts that don't get exposed to corrosive liquids, like bearing housings and adaptors, are typically cast-iron.

Lot sizes run from one up to the 700-800 range. Diameters can range up to 36 in. for vertical turning work, with some of the casting parts weighing up to 400 lb. Tolerances go from plus-or-minus a few thousandths down to tenths for the bearing housings and shafts.

Until the installation of the machining cells, those shafts had been turned on tracer lathes (although they were finish-ground on CNC grinders). Holding close tolerances on the automatics was a chore; often the machinist had to gauge every part.

Duriron's first thoughts were to go to NC. They have other NC machine tools, and knew from experience that NC would speed up the machining, improve accuracies, and more efficiently group the various operations.

Since they also had experience with one worker running multiple NC machine tools, they wanted to implement that concept as well. When they realized that whoever was tending the machine simply had to turn one-half of the shaft, flip it over, and machine the other half, they thought maybe a robot could do the job.

Quality-wise, they were wondering how to maintain size control on the parts and change tools when necessary. When they researched the technology, they found that reliable probing and gauging systems as well as workable automatic toolchangers for turning equipment were readily available.

At that point their thinking jelled. With so many automation elements available, why not invest in a system that can run in an automated fashion? They then went to Cincinnati Milacron to get the job engineered.

The lathe cell contains two CNC lathes, a robot, and a parts conveyor. The lathes are oriented back-to-back, with the robot located between the backs of the two machine tools. It loads both turning centers through access doors in the rear of the machines, thus providing excellent access in front for operator setup. ...

When machining is completed at station one, the robot removes the half-finished part, puts in a new blank, takes the half-finished part over to the second lathe, loads it, and gets another raw part to await the completion of machining at station one.

Lathe number one roughs, finish-turns, and grooves. Number two lathe does some rough and finish turning work and also threads. The lathes are tooled to correspond to the "power" and "wetted" ends of the shafts. The wetted end goes inside a pump, and an impeller screws into its threaded portion. The power end goes to a bearing housing where it's mounted to a motor or some kind of primary driver.

The grinding cell contains two CNC step grinders, a robot (same model as in the lathe cell), a conveyor, and a programmable controller. The latter device monitors all the signals going in and out of the grinder controllers and acts like a "traffic cop" to direct the cell's operation.

The key to Duriron justifying its purchase was, first of all, management's acceptance that certain equipment had to be replaced and, secondly, that the extra technology costs of improved (vs. simply new) capital would be returned to the company in the form of savings in labour, reductions of in-process time, and less rework and scrap.

The new machining cells were not yet quite up to full speed, but even at that stage the time spent machining was probably 50 per cent less than before and that in-process time - from when Duriron buys its raw material to when it sells its finished product - should soon drop drastically.

"Our replacement parts orders are not predictable," Duriron says, "and until we had the machining cells the only way to respond quickly was to maintain large inventory. That isn't desirable with today's inventory carrying costs. The reduction of in-process time via the machining cell setup is our solution to ensure fast service with excellent quality parts."

Duriron is especialy high on the system's flexibility. Not only is it flexible enough to handle the various shaft models Duriron must produce, but the machine tools can also be employed individually for short-run (three-four piece) production of entirely different size shafts.

In those situations, the machinist won't use the robot and conveyor, only the machine tool. Having the rear-load robot setup means the worker can easily go right up to the front of the lathe to break down the setup and program the CNC for the new part. The shop, like many others, handles most of its major programming off-line. They have a CAD/CAM system and are signed up for timesharing as well. The robot is programmed on-line.

Duriron made a very large up-front training commitment to ensure the success of its new manufacturing systems. They sent the job setters, manufacturing engineers and NC programmers involved to all of the courses available for the individual cell components. Cincinnati Milacron also conducted an in-plant class at Duriron for the cell operators.

For safety, they installed fencing to prevent anyone from getting within the robot's reach. If the door is opened, the robot automatically goes into a feed-hold condition.

Quality-wise, the setup is helping Duriron do away with final inspection of parts. The workers at each cell are responsible for each stage of the process, and between that and the automatic gauging at both the lathe and grinding cells, quality is excellent. (Industrial World, September 1986)

Computers improve maintenance system

Used as a sophisticated tool, the computer system supports the maintenance function, helping to improve effectiveness. It makes it easy to accumulate cost information by work order and equipment number and to generate timely reports on costs and performance. Useful information becomes readily available to managers, maintenance supervisors and craftsmen. The guidelines in this article detail improtant factors in establishing and continuing a successful computerized maintenance system.

Conducting an analysis of the company's maintenance function will help to determine whether a computerized maintenance management system is needed. Too often in the recent past, companies in Ireland have rushed out to purchase a computerized maintenance system without examining the total consequences of the investment. It may appear trite but many companies fail to ask themselves the basic question 'do we really need a computerised maintenance system?' The purchase of a computerized maintenance system is no substitute for having effective maintenance management. A prerequisite of installing any computerized system is to establish at least a preventive maintenance system, a work order system and a stores and stock control system.

The aim of preventive maintenance is to combat deterioration of machinery by inspecting, lubricating, cleaning, adjusting and testing. Greasing retards wear. Cleaning removes impurities which can otherwise cause wear, speed up corrosion or cause overheating. By watching out for defects, their consequences can be prevented or minimized; defective conditions are found before they can casue extensive damage to the component or affect other components. Production interruptions can be prevented in good time. Periodic repairs also indirectly prevent some defects from developing to the point where they cause serious damage or breakdowns. The first essential of installing a preventive maintenance system is to draw up a plan detailing for each machine the components that require preventive maintenance, the type of inspection necessary and the frequency. The manufacturer of the machine may be able to help. However a better approach would be to examine each machine, identify what components require preventive maintenance and detail the inspection.

Before any computerized system is installed it would be wise to ensure that the maintenance staff fully understand the objectives of preventive maintenance. Perhaps a manually operated system could be established in a section of the plant to teach the maintenance staff the work associated with and the benefits of preventive maintenance. It is essential in any control system that the preventive maintenance inspector knows for each machine the type of preventive maintenance inspection and the frequency. There also must be a feedback to a central control to ensure that inspections are carried out and if necessary follow-up action is taken as a result of these inspections.

The work order controls the flow of work, helps decide the resources necessary and forms the basis for providing a history of costs and repairs. The work order form should identify the equipment needing work and the kind of work required. A work order may originate from several sources; from production if there is a breakdown, from preventive maintenance inspections if further work is necessary, from management on installation of new machines or from maintenance if modifications to machines are necessary. The work order form should have space for priorities, labour, materials, tools, equipment and time. These forms are forwarded to the maintenance department who allocate craftsmen to carry out the work. The completed work order details actual work carried out, the time taken and parts used. Many craftsmen dislike filling out forms. However, the work order system is an essential part of any computerized maintenance management system. It is desirable therefore that full trade union negotiations take place to ensure the importance of the paper work system is understood by all.

Satisfactory material control means that the needed parts are available in adequate amounts at the right time. Performance of maintenance work is slowed and complicated when labour is not available. However, maintenance work is brought to a complete halt when the necessary materials are not available. Before a sound computer inventory control system is established, it is wise to set up and run a manual system first. This way a plant can work out any problems before spending money on developing a computer system. A manual system provides an excellent training ground for developing material management techniques. (Technology Ireland, January 1987, page 19)

Informatics enters the scene to eliminate traffic jams

While Paris for its part is in the process of validating an expert system to deal with traffic congestion, the City of London has presented a computerized system, Autoguide, to guide motorists in the streets of the capital. It is the Transport and Highway Research Laboratory which is at the origin of the British project which, among others, is already at an advanced level and could become operational by 1990.

The system consists of the placement of a number of beacons at the main intersections and to equip cars with computers capable of providing very simple instructions during the trip over a video screen, of a device with voice synthesizer or of both systems together. The driver, at the moment his car passes, indicates the type of vehicle and if possible his preferences of choice of the various routes. Afterwards, the beacon at the next intersection transmits its suggestion of the route to follow to the driver.

The different data from the beacons are collected in a central computer which constantly updates them, thereby making it possible at any moment to know what the real situation is with regard to traffic in the streets.

The new product has interested numerous companies and, more particularly, those which are already on the market with systems for traffic regulation. In fact, Autoguide is proving itself to be a complementary technology.

As far as Paris is concerned, informatics was introduced years ago in the regulation of the capital's traffic lights. Nevertheless, this simple tool is insufficient and the researchers at the national research institute on transport and its safety have decided to use an expert system to be added to the existing regulation equipment.

The regulation system is based on traffic light plans which establish how long lights along certain lines are to remain green, the range over which these times can vary, etc. Each such traffic light plan corresponds to a given traffic situation, inasmuch as statistical studies have made it possible to establish characteristic situations with regard to sets of intersections grouped into zones.

Afterwards, the machine establishes the regulation of the traffic lights in accordance with each situation. Such traffic light plan calculation is made with the help of mathematical optimization procedures based on known traffic data. The different data are fed into the computer by an acquisition network that covers all the regulated intersections.

The different systems still in the development or testing stage could, in the relatively near future, solve the present difficult traffic congestion problems. (Bulletin IBIPRESS, No. 105, 3 November 1986)

Informatics helps the handicapped

During an international health and welfare exhibition held in Tokyo, the large number and the diversity of the computerized systems designed for persons suffering from physical handicaps could be noted. In the same field, a robot has very recently been presented in London which, thanks to its modest price, could very rapidly become a product accessible to the public at large.

A product developed by a Japanese university was presented during the exhibition. It makes it possible for persons with hearing problems to correct their language errors. This equipment, which consists of a screen, a microphone and a keyboard, is controlled by a simple microprocessor and by a signal transformation device. The new system allows the patient to work independently and to dedicate as much time as necessary to the different exercises. Although doctors specialized in these specific conditions exist, there are too few of them and, what is more, the therapies are particularly long.

Among the other physical aids, we mention a system capable of automatically reading a book, which has been made for the blind. It consists of a device that turns the pages, a scanner, an image processing unit and a voice synthesizer.

Numerous other new technologies were exhibited during the exhibition and the projects presented, some more ambitious than others, open out wide prospects in the sector.

As far as Great Britain is concerned, it has very recently launched a new machine called "RTX" which is composed of a series of interconnected sections capable of lifting a weight of at least two kilograms and to replace it with a precision in the order of one millimetre.

RTX, which was developed by UMI, Universal Machine Intelligence (Company), according to its producers, is the first product on the market in the range between the ultra-sophisticated machines and the low-priced robots intended for children. The new product proves to be a precious aid to persons suffering from physical handicaps and could, in the relatively near future, be accessible to all. (Bulletin IBIPRESS, No. 105, 3 November 1986)

SOFTWARE

Software market 1987

Computer hardware may not be growing like the good old days, but software sure is. The driver: the need for new software to exploit the expanding capabilities of hardware. So Electronics predicts that the software market will grow a brisk 19 per cent in 1987, achieving sales of $14.7 billion. This performance will come on the heels of an 18 per cent growth rate in 1986, to $12.3 billion.

Virtually every segment of the software market is in for a good year. Applications programs will surge 19 per cent to $4.6 billion, on top of a 16 per cent rise and $3.8 billion in sales in 1986. In this category, programs for computer-aided design, engineering, and manufacturing are especially strong. Riding the wave of equipment sales, CAD/CAE software will rise 14 per cent to $665 million, far outpacing its 4 per cent increase in 1986. CAM applications will jump 20 per cent to $720 million, following a 7 per cent rise in 1986.

Systems software will grow 20 per cent to $10.1 billion, Electronics forecasts, compared with an 18 per cent increase and $8.4 billion in sales last year. Within this category, diagnostic and debugging tools will enjoy the steepest rise - 24 per cent to $1.3 billion, on top of a 22 per cent growth spurt in 1986. Operating systems will show a strong 22 per cent gain, to $5.6 billion.

Increasingly, though, software cannot be defined in broad categories. Vendors are positioning their products in more precisely defined niches, and market forecasters see some of these niches as particularly exciting. Among them are the Ada programming language, artificial intelligence, desktop publishing, and personal computing.

Some observers believe Ada, the programming language of the Pentagon, will be one of the big software success stories in the closing years of the decade. A big reason: more than 60 Defense Department-validated compilers are now available, whereas fewer than 10 existed three years ago. The DOD says the 1986 Ada market of $730 million will more than double to $1.79 billion in 1987 and nearly double again, to $3.27 billion, in 1988. These figures include both applications and systems software, as well as the contract value of Ada development projects.

Artificial intelligence is another soon-to-be prominent player. Software billed as containing at least some AI features generated some $200 million in revenue in 1986. The Electronics survey indicates that such software, commonly called expert-system tools and environments, generated roughly $18.6 million in revenue in 1986. In 1987, sales should more than double. And long-term prospects are even brighter with the expected growth in the AI applications market - delivering not development tools but end-user programs.

Desktop publishing, a field that didn't exist five years ago, will grow at a compound annual rate of 43 per cent between 1985 and 1990. The field has exploded with dozens of publishing products from the likes of Aldus, Adobe Systems, Apple Computer, and Xerox. Apple's Macintosh and affordable laser printers have done much to convince end users that personal computers can be cost-effective document producers. As a result, desktop-publishing consumption should climb from some $300 million in 1986 to $380 million in 1987.

In all, the market for personal-computer software should experience a robust growth rate of 24 per cent in 1987. According to International Data Corp., the Framingham, Mass. market researchers, sales will climb to $2.64 billion, up from the 1986 total of $2.13 billion. IDC also says sales of software for minicomputers and superminicomputers will jump 20 per cent in 1987, to $7.9 billion, while mainframe software growth is pegged at 16 per cent growth to $3.8 billion. (Reprinted from Electronics, 8 January 1987, p.57, © 1987, McGraw Hill Inc., all rights reserved)

Software program verifies computerized NC commands

General Electric researchers have developed a software program that can trim weeks and thousands of dollars from process of verifying computerized instructions that tell a numerically controlled milling machine how to make a specific part.

For each part that is produced, a numerically controlled (NC) tape containing machining instructions can be interpreted by the program and converted into a lifelike, shaded-colour simulation that runs on the screen of a Calma CAD/CAM design station. NC verification is part of the Prism/DDM System recently introduced by GE's Calma Co. subsidiary (Milpi[illegible] CA). Researchers developed an algorithm that gi[illegible] the new Calma software its ability to convert each of thousands of individual NC commands into a moving shaded image on a computer screen. The result is an improvement in manufacturing lead-time. In one test, software took only 7 hours of computer time to check the instructions for machining a mould for a plastic frame for a hiker's backpack. It would have taken several weeks to complete the task by conventional cut-and-try techniques.

An advantage of software is that the image portrayed on the screen is a realistic solid model. As the program runs, each motion of cutter is displayed in a contrasting colour before that area of workpiece is removed from the screen. The program does this by subtracting from the workpiece the volume of material encountered by the moving tool. With each pass of the cutter, another change occurs in the shape until the finished piece emerges. Researchers are working on applying machining technology to improve productivity of machining. Integrated with a model of the physical process of metal cutting, simulation software estimates cutting forces and tool deflection. Information is used to calculate optimized feed rate for production. Calma Co. is manufacturing and selling software. (Inside R&D, 26 November 1986)

Engineering software market set to expand

A four-fold expansion in the world market for computer-aided engineering (CAE) software systems between 1984 and 1992 is predicted in a new report from Market Intelligence Research Company of California. The report is based on interviews with 'key industry participants', particularly CAE managers.

In 1984 some 84,000 systems worth $1,500 million were installed worldwide. In 1992 the report says sales are likely to reach 300,000 with a value of around $6,300 million. A significant factor in this expansion is the continuing decline in hardware costs and the introduction of engineering workstations which are bringing CAE within the price range of small companies.

The other major markets for CAE software vendors are said to be in the aerospace, automotive, electronics, plastics and telecommunications industries. Of these, the automotive sector is expected to remain the largest consumer while aerospace is expected to show the fastest growth. (Engineering, January 1987)

Software survey

Materials and Society, published by Pergamon Journals Ltd. in the USA, have introduced a software survey section to encourage the open exchange of information on software programs in the field of materials engineering. With the rapid penetration of computers into academic and industrial institutions has come a parellel increase in the number of scientists and researchers designing their own software whose existence remains to a large extent unknown. With this in mind the editors have designed a questionnaire which is included in the journal and which should be completed and returned to: Professor Walter R. Hibbard, Jr., Department of Materials Engineering, Virginia Polytechnic Institute and State University, 617 North Main Street, Blacksburg, VA 24060.

Computer languages

A language is produced by an intercommunicating group - a collection of humans who find they need to send messages to each other and invent a way of doing it.

But what use is language, one may ask. A human language makes simple communication surer and subtle communication possible; but, in that case, why should there be so many different (human) languages? There has not been the means or incentive to generate a common language. Language is an optional extra outside the genetic code and it has to be invented and learned. Because people did not travel far in bygone days, each intercommunicating group was small and developed its own language or dialect with words for the things they found or ideas they had. Only Eskimos, for example, need 40 different words for snow. Language also became a symbol of group identity - a way to tell friend from foe.

Computer languages have been subject to similar influences. There are many computer languages because, originally, intercommunicating groups were small and each invented its own. There was no incentive for standardization, and perhaps, in a competitive world, artificial differences were introduced to make a product better or to prevent customers from going elsewhere.

It w[illegible] not so long ago that all computers were monsters [illegible] up in fortresses surrounded by acolytes. When a computer cost a million pounds and you could make it five per cent more effective by inventing a new language, you did not hesitate.

However, the small original intercommunicating groups of microcomputer language users grew and amalgamated with fearsome speed. Micros constitute a worldwide culture, and are used by serious professionals for a great variety of purposes. Such users have clear priorities in language choice. They will of course want an appropriate language for the job; beyond that they look for three main factors:

- Standardization - to give an assurance of continuity internationally and with past and future work.

- Clarity - so other people can easily understand what a program does and maintain it.

- Acceptance - the language must be available on a wide variety of hardware and operating systems, and familiar to a broad cross-section of users.

How do the computer languages available today measure up to these requirements?

FORTRAN is the oldest high-level computer language, and its strongest application areas involve numeric computation, though it is in fact quite a versatile language, particularly in more recent versions. There are good standards in existence for FORTRAN. The most recently approved standard was 'FORTRAN 77', although a new 'FORTRAN 8X' has reached an advanced stage in the long and extremely painstaking development process.

There are countless implementations of FORTRAN on machines small, large and enormous. There are many libraries of ready-made subroutines to draw upon, for example to carry out standard evaluation processes or to allow access to graphics facilities. FORTRAN is also much used by those who are not computer professionals. So, for any application involving numerical computation, FORTRAN has to be a serious contender, and if computation is your field, FORTRAN is also likely to be the computing language you learned first.

As FORTRAN is a natural contender for computational work, so is COBOL for a business application. It too is quite old, well standardized and widely implemented, although the standard has so many optional components and levels (to encompass a wide variety of hardware) that true uniformity sometimes seems to have escaped. It is a language which consciously tried to make programs readable, even by non-programmers. Its arithmetic is firmly decimal-based, perhaps less important now than when COBOL was new and computers were gradually taking over from older accounting machines, but still significant for some uses.

In an important way, it is a language of the computer professional; programs may be readable without being easy to write, and indeed some will no doubt feel that the best thing about COBOL is that you stand a good chance of finding someone else to write your programs for you.

PASCAL belongs to a new generation of programming languages, consciously designed round the 'structured' approach to programming. The objective is to build programs in a way that makes them more secure (through internal consistency rules), clearer to understand, and hence more maintainable. Its field is less firmly demarcated than FORTRAN or COBOL, containing influences from both numeric and data processing usage of computers and an important strand from education.

Since the late 1970s it has been a favourite means of teaching programming as a systematic discipline, and many who were brought up on it are now working in or with computers. An international standard was produced in 1982 and is now adhered to by many of the implementations available on a wide variety of machines, including micros.

FORTRAN, COBOL and PASCAL are currently the best standardized computer languages. They are also the languages for which (on the basis of the respective standards) there are independent validation services. This means that a third party has subjected compilers to a laid-down test procedure and prepared a report on the findings. In the UK, the FORTRAN and COBOL services are operated by the National Computer Centre in Manchester, the PASCAL service by the British Standards Institution.

Three languages have been singled out for special mention. What of all the others? It is a hazardous business making recommendations in this area. Like human languages, programming languages generate strong emotional attachments, and it takes a long time to reach a reasonably objective view of the one which was learned first. And since it is usually possible, with skill and ingenuity, to program a given problem in a totally unsuitable language (and even in passing to gain useful insights into the problem), there are no absolute answers. Nevertheless, it seems worth while to make an attempt at assessing the relative usefulness of languages to programming tasks, and the table shows the result.

One language that comes out well from the table is ADA. It is in addition well standardized, but was omitted from the earlier summary due to it not being considered really a micro language (well, not yet anyhow). C and MODULA-2 currently have standards under development with drafts expected, and will soon be strong contenders in their particular fields.

What of BASIC, the staple diet of so many micros? BASIC was originally intended for beginners' programs, and in some ways makes a good entry level language, but because it was designed in the era of paper tape and teletypes, it had to be extended to show off the bells and whistles of each machine with which it was provided. Alas, the result is bedlam, even though a few of the derivatives are very good. Each supplier who tried to shut competitors out discovered that in so doing he was boxing himself in. Furthermore, while BASIC has its value as an illustration for beginners, it is far too ill-organized to be economic for production and maintenance of serious software.

Many of the other languages in the table, while suitable in the facilities they offer, fall down on one or more of the criteria of standardization, clarity and acceptance.

How will matters develop? A process of natural selection operates as remorselessly in languages as in other areas. The currently successful languages must develop or be superseded. FORTRAN has shown great powers of survival in the past, adapting to developments without getting ahead of its natural user base, and must be thought likely to continue.

COBOL has an enormous weight of investment in programs and programmers on its side. There is no established language yet in the micro field for constructing the really large programs the machines are now capable of running. PASCAL is in an established position and has the potential for development in this direction, but might be overtaken by a newer contender. Increasing interest is to be expected in the area of artificial intelligence, with acceptance and, it is hoped, standardization of one of the main languages, say LISP.

A computer language has a dual role, as a conveyor of ideas between humans, and as a means of instructing machines to carry out detailed tasks. Development must balance the two in a relationship which is half logic and half psychology. An important part of the usefulness of a computer language is the body of understanding of it and liking for it and things written in it. The other part is how easy it is for machines to respond to it - which reduces the question to asking whether compilers can be produced at reasonable cost. ADA, for instance, is considerably hampered by its sheer size and complexity.

So how does all this help in answering the original question - which language should you choose? Firstly, the language should be appropriate to the job to be done. Then, for various reasons, one should look for standardization: it improves the chances of finding that relevant pieces of program exist and already work, it widens the choice of hardware capable of being used for the current purpose, and it improves the chances of today's programs (or pieces of them) being useful again tomorrow.

As new standards emerge for related topics such as database organization and graphics, it is their relationship with standardized languages that will be considered; GKS (the Graphics Kernel System standard) for instance, currently has linkages for FORTRAN and PASCAL only. And it is the standardized languages that are supported by third party validation services. By this reasoning COBOL, FORTRAN and PASCAL are best buys.

Definitions of computer languages

ADA

A trademark, ADA is a programming language developed for the USA's Department of Defense for use in systems used for control purposes.

APL

A Programming Language - unusually extensive set of operators and data structures are used to implement what is considered by many to be the most flexible, powerful and concise algorithmic/procedural language in existence.

BASIC

Beginner's All-purpose Symbolic Instruction Code. One of the easiest computer programming languages to learn and master, well-suited for time-sharing.

BCPL

A system programming language that incorporates the control structures needed for structured programming. BCPL has been implemented on many machines, and programs written in the language are readily portable.

C

A somewhat structured high-level programming language designed to optimize run-time, size and efficiency.

COBOL

Acronym for COmmon Business Oriented Language. This is a common procedural language designed for commerical data processing as developed and defined by a national committee of computer manufacturers and users.

CORAL 66

A programming language loosely based on ALGOL 60 and developed in the UK for military applications. It is an acronym for Computer On-Line Real-time Algorithmic Language. Its use is expected to decline with the advent of ADA.

FORTH

A programming language system which can be implemented readily in microcomputers, and which offers solutions to a wide range of problems.

FORTRAN

FORmula TRANslator - a compiler language developed by IBM originally for scientific application but now widely adapted for commercial problems as well.

LISP

Acronym for LISt Processing. An interpretive language, developed for manipulation of symbolic strings of recursive data, i.e. used to develop higher level languages.

MODULA-2

A programming language that is a development of PASCAL. MODULA is used for concurrent programming and like ADA it includes facilities for describing parallel computations together with their interaction and synchronization. Its name derives from the fact that a program is made up of modules.

PASCAL

A language designed to enable teaching of programming as a systematic discipline and to do systems programming. Based on the language ALGOL, it emphasises aspects of structured programming.

PL/I

Compilers are provided for use in compiling object programs from source programs written in this programming language. This language has some features that are characteristic of FORTRAN and incorporates some of the best features of other languages.

PROLOG

A logic programming language, widely used in artificial intelligence. The basic element of PROLOG programs is the atom which expresses a simple relationship among individuals, the latter being named (in the simplest sense) either by constants or by variables. PROLOG has been selected as the basis for the Japanese "fifth generation" computers.

SNOBOL

Abbreviation for StriNg Oriented symBOlic Language. A programming language used mainly for advanced string manipulation. (African Technical Review, December 1986)

NTT builds a LISP machine for Japan

When researchers at Tokyo's Institute for New Generation Computer Technology established directions for Japan's government-backed fifth-generation computer project six years ago, they placed their bets on what was then a relatively obscure artificial-intelligence language: Prolog. Despite the considerable influence of the fifth-generation project, however, Lisp - the AI language most popular in the US - continues to gain popularity in Japan. Recognizing this, Nippon Telegraph & Telephone Corp. has unveiled Elis, a work-station designed to run Lisp programs.

A number of US-made Lisp engines are available in Japan, but none have facilities for use in the Japanese language, as does NTT's Elis. The work station's 64-bit microcoded central processing unit and stack-based memory architecture give it a high level of performance, too. It is said to be several times faster than 3600-series machines from Symbolics Inc. of Cambridge, Mass.

Most expert-system programs marketed in Japan are in Lisp, but a lack of data-base material, especially in the medical field, and a lack of AI specialists (industry sources say there are only a few hundred at present) are restricting market growth. None the less, analysts predict the market for AI systems in Japan will grow from its current modest 20 billion yen ($130 million at current rates) per year to 1 trillion yen ($6.45 billion) by 1990.

Lisp engines from Symbolics are among the US AI machines marketed in Japan. They are sold by Nippon Symbolics Ltd., a joint venture of Symbolics and the Nichimen trading house. IBM, Digital Equipment Corp., and Symbolics hardware is also available as platforms for Intellicorp's Knowledge Engineering Environment through CSK Research Institute Ltd.

None of the US machines, however, has Japanese-language support. For Elis, NTT has developed Japanese-language data-input facilities for use with English-language programs.

The result of a four-year project, Elis will be on the Japanese market by late next summer, say NTT engineers. Production in the first year will be small, only 20 to 50 units, manufactured by Oki Electric Industrial Co.'s plant at Takasaki. NTT says it hasn't set a price yet for Elis, but NTT feels the product will eventually be a money-earner.

The first Elis prototype had about half the logic of its 64-bit CPU implemented in 2900-family bit-slice chips from Advanced Micro Devices Inc. and the remainder in Schottky TTL. Much of that logic has now been replaced by one 20,000-gate array chip. This makes it a more compact unit that can sit beside a desk and accommodate four terminals.

A Motorola 68010 microprocessor serves the work station as a front-end processor handling all input/output tasks. It controls a 16-bit bus to which disks, terminals, and other peripherals are connected. A direct-memory-access controller ties this bus to the 64-bit CPU bus. A floating-point accelerator and main memory are tied to the CPU bus.

Among the notable features of the CPU are a very large writable control store - 64-K words of 64 bits each - for microinstructions, which support a Tao interpreter. Tao is a dialect of Lisp.

To run programs written in Common Lisp, some functions not found in Tao - about 10 per cent of the functions of Common Lisp - are added in a separate software package. Tao also has functions that support Prolog and Smalltalk.

Fast memory access is a major performance factor, Sakai says. In addition to main memory, which can be as large as 128 megabytes, there is a 32-K-by-32-bit bank of fast static random-access memory configured as a first-in, last-out stack. (Reprinted from Electronics, 30 October 1986,)

Commercial interest in natural language processing

According to a report distributed by International Planning of Information based in Copenhagen, interest has been increasing considerably since 1984 in the informatics processing of natural language - its increasing applications - the fact that integrated circuits are becoming cheaper and performing better, along with the advances in software development, is working in favour of this even though, according to the report, no firm has as yet been found that admits to having earned money in this field. Although the experiment is very important, both firms and personnel require time to master the complexities of natural language and to develop grammar books and dictionaries - nor are firms with over 10 years of experience able to ignore this fact. The initial cost to enter these activities is low, but it is forecast that it will undergo a rapid increase.

The activities in which natural language processing is applied are: interfaces with databases which allow easy consultation by non-specialists, interfaces with microcomputers, dialog interfaces to allow the generalization of the use of expert systems and informatics systems for training, reading by scanner of telexes, bank and commercial messages to extract the essential content and suggest degrees of priority, word processing software that make possible the revision of texts as to grammar and style, machines to assist in translations and converters of dictation into written texts, an application for whose development IBM, NEC and Plessey have set up specialized subsidiaries.

The first informatic processing of natural language harks back as far as 1950 to 1964, in which the main aim was automatic translation. Because it was then thought that it was enough to have large dictionaries and to apply rules of syntax, those approaches failed miserably. During the period from 1964 to 1969, systems restricted to fields such as the Student who transformed English texts into simple algebraic problems were developed. Afterwards, the role of semantic-pragmatic models has increased during the search for the meanings of words, by using the theory of predicates and the theory of scenarios. At the moment the three furthest developed applications are: computer-assisted translation, interfaces with databases and word processing with correction functions. (Bulletin IBIPRESS, No. 105, 3 November 1986)

Software liability

Liability lawsuits have hit the computer software industry. The results could be higher software prices, less innovation, fewer programs for applications where liability would be especially risky, and a restructuring of the industry.

In a case filed in October 1985, James A. Cummings, Inc., a Florida construction firm, claims to have lost about $264,000 because of faulty results from a program by Lotus Development Corp. of Cambridge, Mass. Lotus maintains that Cummings misused the software. The suit turns on the concept of "information liability" - responsibility for the information contained in or produced by a product.

Peter Marx, chair of the New England Computer Law Forum, points to two suits that illustrate the complexity of information liability. In one case, now under appeal to the US Supreme Court, lower courts held the National Weather Service liable for the deaths of four fishermen off Cape Cod. The fishermen lost a boat in a storm after a forecast of calm weather. A district court overturned the verdict on a technicality, but let stand the precedent holding an entity liable for information it provides.

In the second case, Jeppeson Sanderson, Inc., of Colorado was held liable for an airplane crash caused by faulty data on flight patterns. Jeppeson Sanderson copied the data accurately from incorrect Federal Aviation Administration information. The company had to pay $12 million in damages.

A software purchaser may pass on information gained from a program to other people, so if companies are held responsible for the information their programs produce, they face almost unlimited liability. But information liability for software is especially tricky to assign, says Geoffrey Berkin, who is associate counsel for Ashton-Tate, one of the nation's largest personal computer software manufacturers. "What constitutes a defect is relative. In software, you can't measure things with a scale and a ruler." Moreover, he notes, "We can't make sure a program is going to be used correctly. I don't think it's fair to say that if we sell you a program we're responsible for every possible consequence."

Ken Wasch, executive director of the Software Publishers Association (SPA), goes further. "There's not a publisher who could certify that a program doesn't have bugs." Indeed, bugs seem almost inevitable as companies rush programs into the marketplace. This haste makes innovative products available months earlier than they would be otherwise. A page-layout program that SPA bought last year proved full of problems, Wasch notes, but SPA still "received enormous satisfaction and utility from the product".

Marx disagrees. "Just because everybody is doing it is no defense." Moreover, he suggests that software publishers already take some responsibility for their products. "Clearly if you're building software for air traffic control you're going to put more controls and precautions into it than into computer games."

Richard Perez, an Orinda, Calif. lawyer specializing in computer law, believes software publishers ought to be forthright about the capabilities and failings of their products. Being honest about a program's weaknesses affords the vendor some legal protection. "There's nothing wrong with having a product that's not quite perfect if you tell people that," he says.

Industry observers agree that software liability may have significant economic repercussions. Among the first repercussions would be a rise in software prices. Right now, the cost of liability suits "is not built into software pricing," explains Wasch. Furthermore, Marc Rosenberg, vice-president of the Insurance Information Institute in Washington, D.C., is not aware of any insurer that sells coverage specifically for information liability. Damage claims may be covered under some product liability or umbrella insurance policies, but if suits become common, rates for these policies will skyrocket.

Liability suits might also force software manufacturers to avoid high-risk areas. "Consider the medical programs that are available now - computer-assisted diagnosis," Rosenberg points out. "You're talking about the software designer being sued for medical malpractice." Other software is available or under development to prepare income tax returns, detect weak spots in highway bridges, and diagnose problems in the cooling pumps of nuclear power plants.

Liability would also affect access to venture capital. Private venture-capital investors may choose to put their money where "the risks are more contained," says John Hodgman. He is president of the Massachusetts Technology Development Corporation, a state authority that finances high-risk, high-tech, start-up firms and encourages private investment in such firms. Hodgman expects risk to weigh particularly heavily for large investors.

Much depends on the Lotus-Cummings case, which may not be resolved for several years. "I suspect strongly that the case may be settled out of court," states Wernick. Lotus has to decide "whether to spend umpteen million to defend a case or to settle for somewhat less." (<u>Technology Review</u>, January 1987)

<u>Expert systems</u>:

<u>Expert shells are ready to become sensible</u>

Expert systems are throwing off their cranky image. They will soon play a significant role in a number of industrial markets.

Several key factors are coming together for expert systems this year. These include a rush of custom-built systems for internal use by large US corporations, and improved integration of expert systems with other kinds of computer equipment.

There are also clear signs that expert systems offer commercial advantages; and they have attracted the open backing of the world's largest computer company, IBM.

By 1990, according to market research group Dataquest, the European expert system market will have soared to $3.8 billion from $134.9 million in 1986.

Less than 2 per cent of the market will be tied to academic and research institutions compared with over 8 per cent at present.

The oil, aerospace and data processing industries already employ expert systems. But the latest developments are in the financial sector, where companies are trying frantically, to steal ahead of each other in the smoke of the Stock Exchange's Big Bang.

An expert system is a collection of rules siphoned from a human expert or group of experts and crystallized in a computer language - usually Prolog, Basic or C. The rules are then applied to problems - and offer solutions based on the knowledge they embody.

The market has a secretive aura. But this is not some wizardry inherent in expert systems themselves; it is the secrecy of people protecting a competitive edge.

Although expert systems sprang from attempts to model human reasoning by computer, the lofty ideals of artificial intelligence are now giving way to commercial sense.

Data processing could be the biggest market for expert systems, according to Alex D'Agapeyeff, chairman of Expertech, which provides consultancy to DP departments at Rolls Royce, Thomas Cook, W. H. Smith and the Metropolitan Police through an Alvey-sponsored club.

A number of new software packages are now on the market to help companies such as these apply expert systems to DP problems.

This summer ICL released a product for capacity management and planning called the VME Capacity

Management System (VCMS). It was snapped up by 30 DP managers in its first month.

Communications company Case is to launch an expert system called Nconf, which automatically reconfigures communications networks.

DP departments may feel they can show a leg now that IBM has clearly signalled its support for expert systems and proclaimed its own use of them.

IBM announced plans for a new family of expert system products at the AIII artificial intelligence conference in Philadelphia in August 1986. The software will be compatible across PC and RT micros, System 36 and 38 minicomputers and 370 mainframes.

IBM also announced regional support centres for artificial intelligence in the US and a gift of 225 RT PCs to Carnegie Mellon University for artificial intelligence research.

The company uses expert systems extensively on its own production lines. They are used for fault diagnosis, and for deciding whether particular components should be made or bought.

"IBM has definitely given its seal of approval," says Mike Turner, an expert systems consultant with PA Computers and Telecommunications. "It sees expert systems as particularly suited to memory-hungry, processor-intensive mainframes.

IBM has to increase the power of its computers by 20-25 per cent a year to counter falling hardware costs, says Turner, and artificial intelligence appeals as a market that could need that power.

This is true of the financial sector in particular, as this is where US companies are already proving the commercial viability of knowledge-based systems.

For example, a package from US software house Apex allows many middle-income customers to afford professional financial advice for the first time. It cuts a 60-hour consultation process down to five or six hours and frees human financial advisors to take more customers at lower prices.

Another system developed by US bank Coopers and Lybrand offers tax consultancy to Coopers' 10,000 corporate customers. It will reach all the company's US offices by the end of the year - freeing experts from routine tasks.

In the UK, the Big Bang has opened the City to foreign companies. And this will bring the UK face to face with advanced US technology.

The US market is "two years ahead of the UK - plus or minus two years," according to Jeremy Clare, an analyst with Cambridge Consultants. American companies may make big inroads into the UK - but they will also speed up British developments.

Dealing rooms will be one of the first big markets over here, says Clare, because "the only raw material is information". Dealers make their money by being smarter than other dealers, and any device that gives them an edge is worth paying for.

The Midland Bank, for example, has developed an expert system on DEC Microvaxes. This will soon be supporting dealing-room decisions.

So far the most respectable expert systems have been custom-built by companies for their own use. But one area in which the UK leads the US is in cheap, off-the-shelf expert systems for micros, and these are rapidly becoming more powerful.

Companies like Expertech, Intelligent Environments, Expert Systems International and ISI, offer expert system "shells" for £500 or £600, which users can adapt for many different tasks.

Programmed shells can help companies understand complicated legislation, such as the Data Protection Act, or give advice on investment, loan and insurance applications, or provide a starting point for internal research.

To date their incompatibility with existing computer equipment and software has been a stumbling block for many companies.

But this problem will fade away. As micros become more powerful, so do the shells - and the latest systems link with databases and spreadsheets and can bring in lumps of Fortran from external programs.

Improved shells may prompt big corporations to start buying in volume next year. Two UK banks are already considering orders of up to 1,000 shells, and the world's largest bank, Citicorp of New York, is considering ordering 3,000.

But these packages are still crude when compared with a specially tailored system like that used by British Petroleum to design gas-oil separators.

This saves hours of an engineer's time by putting all the repetitive and routine thought processes on a computer.

It is probably the biggest expert system in Europe - with 2,500 rules. And BP has shattered a few records by developing it in a single man-year.

All the big oil companies have artificial intelligence teams. The industry is one of the most advanced markets for expert systems. Current and future applications include prospecting, burner maintenance, plant control and oil trading.

Ironically, expert systems show little sign of taking off in medicine - once seen as their natural habitat.

But if expert systems succeed in the City, then other markets will follow suit with confidence. Expert systems are coming into their own as an unofficial uniform for those who want to be different. In a few years that could be everybody. (Computer Weekly, 6 November 1986, pp. 58/59)

Shell game

The number of shells - specialized tools for the creation of expert systems - has been increasing so rapidly that a potential user can easily become confused.

The technology is relatively new, and the shells now on the market are usually either general-purpose or designed for a very limited number of specific applications. A user wishing to create an expert system using a shell will most likely have to sacrifice something or be willing and able to adapt the products to his individual needs. Therefore, a clear concept and a sound definition of requirements should determine the choice of tools and functions.

The man-machine interface is naturally important a flexible language, windowing, clear menu trees, graphics, a speller, a dynamic knowledge-base generator, and an effective help function will render the shell user-friendly. (Bulletin IBIPRESS, No. 113, 25 January 1987)

The market for expert systems

Until a very few years ago, the term expert system was used frequently only among researchers in artificial intelligence, but, according to various estimates, the value of the market for expert-system products and services will be US$140-US$200 million this year in the US alone and, by 1990, should reach as much as US$1.5 billion. Companies marketing expert systems in chemistry, education, the law, agriculture, geology and oil prospecting, personnel management, banking, engineering, electronics, manufacturing, and medicine are advertising in mass-circulation magazines and selling their products to a wide spectrum of users. Expert systems are now available in such esoteric areas as fog forecasting, avalanche prediction, diet control, traffic management, and even the production of Swiss cheese.

Expert systems greatly expand the range of problems accessible to computers from the relatively small class for which algorithms can be written to the much larger class for which solutions may require the application, in a nonalgorithmic fashion, of significant human expertise.

Designed to help a nonspecialist emulate the approach which a specialist would use to solve problems, an expert system differs from a conventional computer program in that it employs an organized knowledge base to identify and extract relevant information in a process called knowledge engineering. The inference mechanism is the software used in this process. Some software houses offer expert shells, which are ready-made inference mechanisms, and relatively low-cost software is now being marketed so that users can personally tailor expert systems on microcomputers.

Investments in this new tool have begun to grow. For example, Financial Advisor, a financial-management expert system on the market, has been developed at a cost of US$5 million by Palladian Software, which was created by a group of professors at the Massachusetts Institute of Technology only two years ago, and, in Great Britain, a public health-care expert-system project valued at 6.5 million pounds sterling is causing government employees to raise their eyebrows.

The computer industry has not been slack in developing applications. One large American firm has designed an expert system which can turn a rough summary of the capabilities and components desired for a computer installation into a finished and effective configuration. The company has estimated that the system saves it close to US$30 million per year. The same company claims that, if an expert system cannot reduce costs in a particular area by 90, then it is probably not worth developing. (Bulletin IBIPRESS, No. 109, 30 November 1986)

Expert-system writing for the amateur

It used to be that so-called expert systems were restricted to big computers. Increasingly, however, these software programs, which impart an expert's knowledge to help people perform their jobs better, are finding their way down to even personal computers. ExperTelligence Inc., of Santa Barbara, Calif., has come up with an artificial intelligence program that lets you design your own expert system for your Macintosh Plus from Apple Computer Inc.

ExperTelligence claims that its new Interface Builder software program enables a doctor who has no prior knowledge of computer codes to write an expert system that does simple diagnoses. Or an accountant who doesn't like the way his accounting package is laid out could add to its menus or reconfigure it simply by using the Mac's mouse to make changes in the program. Interface Builder will be available from most distributors of Apple software beginning in March. Suggested price: $395. (Business Week, 16 February 1987)

COMPUTER EDUCATION

Informatics and national education in France

The Minister of National Education of France has announced that Edutel, a telematics service, should be operational by 2 March. He has also presented the second phase of a modernization scheme in courseware.

Edutel can respond to 600 inquiries simultaneously and can be accessed at any one time by 7,000 units. Eventually, it may be linked to existing databases in the educational system and be used to provide regional information.

For the cost of a telephone call, a minitel user will be able to access two educational bulletin-boards. One will offer faculty and staff information and an electronic-mail service. It will be used for administrative information, especially information on staff and faculty changes. The other will offer educational-news summaries and practical information to students, parents and local officials. It will also be able to function as a medium of communications between faculty and users. Through the system, opinion polls will be taken on a continuing basis among teachers and students, and the results posted on terminal screens in real time.

The Minister of National Education stated that existing software products were not expected to be eliminated through the new phase of the courseware modernization scheme. Rather, teachers would be offered elements to select appropriate products and the development of new, high-quality software would be encouraged.

Courses in informatics will be developed in primary and secondary education and, by 1988, a pre-university degree will be available. Finally, by the autumn semester, school science laboratories will be required to offer informatics equipment. (Bulletin IBIPRESS, No. 117, 27 February 1987)

Teacher training in computer science

ICE, the Education Science Institute of the Universidad Politecnica de Catalunya in Spain, has developed a training programme for computer-science teachers in primary, secondary and professional education.

ICE is very aware that the application of computers in teaching institutions can offer many benefits and that a serious effort in teacher training, not only in technical areas, but also in educational methods, represents the only way to achieve an intelligent and positive application in schools. Beginning with a small group of interested and knowledgeable teachers, it therefore created a working group and undertook an intensive programme of training for the members of the group so that they would be qualified to teach other instructors, analyse the requirements for teacher-training throughout the educational system, identify appropriate course areas, examine the availability of resources, such as software, develop new resources, such as high-quality courseware, and initiate the general application of courses of study as these emerge from research.

After three years of work, ICE has acquired substantial human and material resources.

Furthermore, it has developed a teacher-training programme which has proved very successful - some 400 teachers are participating each year. The educational resources which have been created, with the financial support of the government of Catalonia, have been used to meet the teacher-training requirements of pilot projects for the introduction of computers in education in that region. (Bulletin IBIPRESS, No. 117, 27 February 1987)

Computers target adult illiteracy

The battle against illiteracy, once fought mainly with chalk and print, is now being waged electronically. A computerized learning centre called PALS (Principle of the Alphabet Literacy System), recently introduced by IBM, is designed to teach reading and writing to teenagers and adults whose skills are at or below the fifth-grade level.

A PALS centre typically consists of four videodisc systems linked to eight PCjr computers, four PC/XTs, and four electronic typewriters. Students use the PCjrs and the typewriters along with lesson manuals to practice writing exercises, learning to touch-type as they go. The PC/XTs enliven reading lessons with videodisc-based comic books that students control by touching the screen. At the same time, a computer-stored voice speaks the dialogue that the student sees on screen.

PALS isn't cheap; a complete centre costs $72,000, or $60,000 with an educational discount. But IBM says the system can accommodate 500 students a year - and it seems to work. In high-school trials of the system, students' reading skills improved by an average of three grade levels after 20 weeks. IBM plans to make PALS generally available in the second quarter of this year, and expects it to be used in such settings as junior high and high schools, correctional facilities, and civic organizations. (High Technology, January 1987)

ROBOTICS AND FACTORY AUTOMATION

The state-of-the-art and trends in robotics

Gabriel A. Ferrate, the President of the Universidad Politecnica de Catalunya, Spain, has undertaken a study of the state-of-the-art in robotics for IBI. A brief examination of this study reveals the current areas of application and trends in robotics and current areas of application and trends in robotics and demonstrates that the field of applications is expanding progressively and rapidly, although robots which compete for jobs with human workers and still a long way off.

In industry, the leap from product and parts handling applications, based on the use of manipulator arms, programmed either mechanically or by means of a memory device or other programmable control machine, to the use of computers as control devices and in the analysis and design of programmable robot movements has led to the appearance of the modern industrial robot, which can perform more complicated tasks.

None the less, even though the robots available on the market today are multipurpose and automated, they still cannot be used to perform tasks which require changes in operation according to unpredictable or irregular variables. For any single application, they can only be programmed to perform functions which are determined by one or more specific and predictable variables. Furthermore, the programs used to control modern industrial robots must describe, in detail, the movements and actions to be executed. Programs based on simple descriptions of the objectives to be achieved are not yet feasible. Currently under research, this approach will require robots which can automatically produce programs to achieve specific objectives and can effectively communicate with their surroundings through artificial-perception techniques, such as visual and tactile sensors.

Recent advances in artificial intelligence, computers which can learn automatically and pattern recognition are promising. Industrial robots may indeed eventually be able to collect data on their surroundings and, without the intervention of human operators or programmers, adapt their movements as changes occur. None the less, even if the utmost advantage is taken of the great potential offered by micro-electronics, especially in sensor technology, robots with capacities which bring them into direct competition with human workers are not now feasible except in the context of a limited number of repetitive factory jobs. Robots lack the sense-motor co-ordination and the power of rapid, overall decision-making that are necessary to perform well in a varied, variable and unpredictable environment.

The difference between those jobs which robots can perform easily and those which they will probably never be able to perform is very fine. It has little to do with complexity or the precision required, but depends on programmability. A job is difficult for a robot if it involves constant choices in realtime that must be made according to criteria which cannot be reduced to sets of equations.

In 1984, there were approximately 53,000 robots in the world, of which 21,000 in Japan, 19,000 in Europe and 13,000 in the US. The fact that, since then, the number of robots sold each year has reached approximately 7,000 in the US - with corresponding increases in sales in the European countries and Japan - gives some idea of the dynamic nature of the current market.

The impact of this expanding market on industrial productivity and employment in these countries is a complex phenomenon, which requires detailed case-studies. However, in general, robots do not seem to have had a negative impact on employment in these countries so far. Indeed, they have increased competitivity in the industries in which they have applied. Many of these industries could not have remained competitive on international markets without them.

Although robots have been accepted, for several years, as automobile "workers" in the sense that the majority of applications have been carried out in the automobile industry, the use of robots in other sectors has been increasing in the industrialized countries since 1980, and the number of robots has grown considerably.

Because they are adaptable and can be programmed, industrial robots have become essential elements in flexible manufacturing systems. In order to meet the varying requirements of production processes, the robots in these systems can automatically modify operations protocols in order to adapt to the introduction of different parts on a production line or changes in a sequence of operations. Through the use of robots in flexible manufacturing systems, factories are ceasing to be places where uniform products are mass-produced on super-specialized machines; they are becoming flexible workshops where a wide variety of products can be run off in small batches. Changes in production runs are implemented not by altering the mechanical structure of machines, but merely by modifying the programs which control and synchronize the machines and such peripheral devices as digital-control machines and maintenance and storage systems.

At the same time, important advances are being made in these areas. A great deal of research is being carried out in the development of artificial hands, arms and legs for the handicapped, on two-legged and hexapodal movement for mobile robots, androids and zoomorphs, and on mobile robots which can keep their bearings and move through even labyrinthian surroundings without becoming lost. (Bulletin IBIPRESS, No. 117, 22 February 1987)

Robotics market

	[illegible]	1987 (millions of dollars)	[illegible]
Applications			
Assembly	$ 300	$ 405	$ 970
Material handling/ Machine loading	430	530	800
Painting	190	210	720
Spot welding	400	390	490
Arc welding	250	315	700
Machining—other	220	245	300
Total	$1,800	$2,100	$3,000
Industry			
Automotive	$1,050	$1,130	$1,550
Electronic	450	570	1,100
Other industry	300	400	1,000
Total	$1,800	$2,100	$3,000
Region			
United States	$ 600	$ 600	$1,250
Japan	700	910	1,300
Europe	450	550	950
Rest of world	50	60	150
Total	$1,800	$2,100	$3,000
Shipments			
Automotive units	17,510	19,200	28,500
Electronic units	14,430	18,490	32,950
Other units	6,000	8,340	17,000
Total	38,900	46,000	78,000

(Machine Design, 13 November 1986, p.4)

Slowdown in robotics use

The development of the use of robotics in the production processes of the mechanical industry seems to be proceeding somewhat slower. Large car manufacturers, pioneers in this field such as Volkswagen in FRG, have decided to destine only from 4 to 7 per cent of their investment funds to the robotization of their plants.

According to a survey recently conducted by a British group and a study made by the International Labour Organisation (ILO), 44 of the companies which had begun to use robots have not judged the experiment a success and 22 have abandoned them completely for reasons linked to the qualification level of shop personnel.

For many companies robotization is becoming a problematic choice, also in light of the fact that it does not always provide the results and advantages expected. This does not, however, mean that robotization is any less a vital choice for many companies, because it increases profits and therefore market competitivity.

At company level the main advantages may be stated as being in the quantity and quality of work performed by robots. One of them can do as much work as two and up to five workers who can, in turn, be used for other more demanding and diversified tasks. A robot-hour of labour, moreover, costs the firm approximately US$6, whereas a man-hour reaches US$23.

At the socio-economic level it has been demonstrated that the robotization process does not imply a reduction in work force and hence in greater unemployment. Countries with high levels of robotization such as Japan have a much lower unemployment index than Western countries with minimum production-automation levels which, instead, have high levels of unemployment.

Also to be drawn from the survey report are the predictions that within the next decade in industrialized countries the number of robots installed is destined to triple if not quadruple and to attain 60 thousand units in the USA, 70 thousand in Japan and 25 thousand in Great Britain and Sweden.

Also in the industrially most advanced socialist countries such as the Soviet Union, Czechoslovakia and the German Democratic Republic, it seems that the growth rates in robotics will increase sufficiently to attain 200 thousand units by 1990. (Bulletin IBIPRESS, No. 106, 11 November 1986)

Robots struggle on

The robot industry was handed a major setback when GM sharply cut back its orders for GMF robots. GM is, or was, responsible for 3/4 of GMF's orders and the order reduction is said to have meant the disappearance of $88 million in orders. Although this makes sales statistics look a bit weaker than predicted, there are still strong signs of continued industry growth. A few of the noticeable trends are:

Packaging: Reduction in the purchase of stand-alone robots and more interest in packaged systems. The market for the "un-integrated" robot is becoming saturated, at least in the larger plants.

Manufacturers want total systems including the robot(s), software, sensing systems, and auxiliary automation (part feeders, for example). Because not all manufacturers are interested in taking on the task of making up such packages on their own, there has been a growth of turnkey suppliers, or consulting houses that will be responsible for making up and installing robotic systems.

Manufacturing: Greater interest in robotic assembly. Robots used in assembly are now exceeding the number used in parts handling. This, in turn, is due to great improvements in robotic performance particularly repeatability, speed, and cleanliness. The advent of reliable, easily used, and easily repaired vision systems has also improved the robot's assembly capabilities. Assembly applications are found chiefly in small precision operations and in the automotive area.

Detroit's interest in automation has spawned the philosophy of simultaneous design in which both the problems of product assembly, and its operating capabilities are considered in the initial design.

More applications: The robotic industry would like to break away from its dependence on automobile production and is, therefore, pushing into other areas. Pharmaceutical houses are using robots in some of their operations because of their reliability. Food processors, particularly the beverage industry are using more robots.

Aerospace is trying hard to make the robot practical on the aircraft in aircraft assembly.

Many industry observers say that the mobile personal robot is the industry's sleeper. Most personal robots are complex toys with little limited practical value, but their success may come in a slightly different area: invalid care. The simple tasks that fully mobile humans take for granted can be performed for the elderly and infirm by robots. (Machine Design, 13 November 1986, pp.2/4)

Robot requirements

Any robot can be used in an assembly task. But only a few are suitable for high precision or high-volume assembly. The important characteristics to consider are:

Work envelope: Where the robot can reach is essential and must include the workpiece area and all part supply systems.

Payload: The maximum useful load a robot needs to be able to handle for assembly is given by most analysts as 10 kg. This allows the robot to work with 85 per cent of all manufactured parts. PCB board assembly tasks require little payload capability. Payload should be determined by the dynamic load the end effector can carry.

Speed: Most assembly robots can reportedly serve assembly functions with speeds below 0.8 m/sec. Acceleration and deceleration time must be considered in speed calculations.

Drives: Because of the speed and accuracy requirements, most assembly robots have most of their axes driven by either AC or DC servo motors. Pneumatic actuation is frequently used on the end effector and possibly the z axes.

Repeatability: Most robot manufacturers do not stress accuracy but repeatability: how well the robot can repeat its travel to a specific point. Accuracy may be good in one plane of motion and poor in another; therefore overall accuracy is difficult to determine.

Programming and communication: Although robots from different manufacturers cannot say much to each other, they can communicate basic triggering signals. Therefore the more RS232 ports available the better if complex systems are involved. Normally, more elaborate exchanges between robots such as reprogramming information is handled through a host.

Cleanliness: Lack of contamination is essential in any assembly operation and is especially important in electronics work. Operations must meet clean room standards.

Some robots are available with clean room "packages". Others are designed specifically for clean rooms so that they generate a minimum of particulate matter from paint or wearing particles. Lubricants can also be a problem. They can generate contaminants by off gassing. Areas of the robot where particles might be generated are encased in special boots. Other critical areas may also be enclosed and a vacuum drawn on the entire robot.

End effector: This part of the robot must be selected after a review of the components to be carried. Compliance of the end effector will be based on how fragile the part handled is and any desired error compensation.

Grippers capable of working with several parts simultaneously can speed assembly when part feeding and placement requirements are favourable. Changeable grippers for a single robot may be cost and time savers, if product configuration and production speed requirements allow. This lets one robot use several tools. (Machine Design, 13 November 1986)

Two clear trends in industrial robotics

Two trends could be readily identified at the 16th International Symposium on Industrial Robots, held in conjunction with the recent Robotex exhibition in Brussels.

First, the growing number of seam tracking arc welding robots. Many were demonstrated, from those that performed a dummy run to establish and learn the location of the seam or joint before carrying out the actual welding run; to those which locate the start of the joint, follow its true position and can even alter the amount of weld filler metal deposited to match the joint's profile.

Second, the advances made in vision systems, now a practical method to guide robots in: assembly; handling materials; laying down adhesives; and carrying out inspection duties. (Machinery and Production Engineering, 7 January 1987, p.13)

Robots get 'ears' for better depth perception

Bats "see" in the dark by sending out sounds at up to 100 KHz that bounce off objects. Borrowing that principle, researchers at Siemens AG have developed a sensor system that can enable a robot to distinguish between objects spaced only 0.1 mm apart in depth at a distance of about half a meter, which is within the working range of a typical robot arm.

Dubbed Echovision by the researchers, the system achieves this resolution with a new type of electro-acoustical transducer. Its piezoelectric foils generate and send out short bursts of broadband sound pulses that are far above the range of human hearing. Reflected by the object and picked up in a similar transducer, the ultrasound pulses are evaluated to determine their propagation delay and hence the distance to the object.

Thus far, the Siemens team has developed a fully functional model of the Echovision system. "The Echovision approach could lead to a high-speed, depth-profiling object-recognition system at a cost that is a fraction of that for optical equipment," says Peter Kleinschmidt, who heads the sensor-development team at Siemens's Central Research Laboratories in Munich.

Kleinschmidt says that work on making robots hear in order to distinguish between objects is going on at universities and electronics companies around the world. But he believes that no system developed elsewhere sports a resolution near the 0.1 mm value of Siemens's new system.

Echovision has several advantages over optical sensing devices used in robotics. The most obvious is that it provides a depth of field in a simple way. Optical methods yield a third dimension or a depth profile only by using complex schemes based, for example, on two cameras employed in conjunction with scanning and light-sectioning techniques.

Further, evaluating and processing sound signals requires less hardware and software than does analysing pictures and handling video signals. With sound travelling at about 340 meters/s, or roughly a millionth the speed of light, the sound information comes in at a rate that can be handled without the need for elaborate hardware.

What's more, unlike cameras, acoustic transducers are not easily damaged, and they shrug off dirt or dust. So they are well suited for the adverse industrial environments robots often encounter.

Echovision is also much faster than comparable optical systems. The ultrasound pulses contact an object for only 1 ms, including signal processing. This means that the system can recognize 1,000 objects a second. That is 100 to 1,000 times faster than it takes video techniques to identify objects.

As for the system's key item, the proprietary transducer, it consists of about 20 piezoceramic foils and polymer layers that are stacked alternately and pressed together to form a solid element. The foils are 0.15 mm thick and the polymer layers 2 mm thick. When electrical pulses are applied to the foils, the element vibrates and produces ultrasound pulses in the air at 80 to 400 KHz. The function of the acoustically optimized polymer layers is to attenuate the ceramic foil's vibrations. (Reprinted from Electronics, 8 January 1987, pp. 41/42, © 1987, McGraw Hill Inc. all rights reserved)

"Dr KT 25 will now install the artificial heart."

Japanese FMS get the nod

According to a study published in the latest issue of the Harvard Business Review, the Japanese are effectively using flexible manufacturing systems (FMS) to gain a competitive edge on the Americans.

In the study, Ramchandran Jaikumar, a professor at the Harvard Graduate School of Business Administration, has compared 35 systems in the US and 60 in Japan - more than half the FMS installed in each country.

Unlike manufacturers in Japan, the Americans use their systems as though they were merely sophisticated, but conventional, assembly-line technologies. The American FMS are typically employed in large production runs for only a few products. While such an application can increase productivity and turn out quality products, it is a costly way to use the systems.

The Japanese FMS, on the other hand, are used to produce an average of 93 parts, in contrast to the US average of 10, and run off 22 new parts for every one produced by the American systems. Thus, the Japanese are employing FMS to offer more specialized products to a wider number of individual customers.

Jaikumar also found that more than 40 of the FMS workers in Japan are engineers who have been especially trained in computer-controlled manufacturing technology, while only eight of the FMS staff in the US have engineering degrees and the majority of these have no background whatsoever in informatics.

Furthermore, while experts not only design and install the Japanese systems, but also stay on, sometimes for several years, to operate them and work out the bugs, the Americans use specialists only in design and installation. The result is over-complicated systems and relatively frequent breakdowns. (Bulletin IBIFRESS, No. 110, 7 December 1986)

Automation in SMI

Flexible manufacture: the installation of a KTM Fleximatic FM100 at GKN Light Axles Division's Witton (Birmingham) plant has allowed the company to achieve previously unattainable levels of flexibility in manufacture.

The site manufactures a range of axle components, and while their internal arrangements are to standardized design, external casings are often to customer requirements. Involvement with Jaguar's latest model, the XJ40, provided GKN with the incentive to adopt flexible practices.

On the new car, the differential casing acts as a stressed member with a number of suspension components attached to it. Therefore, instead of two or three locating and fixing holes on the outside of the casting there is a much larger number.

Achieving the necessary tolerances, while coping with minor design changes, demanded a method of machining that was flexible and accurate.

KTM won the order and supplied a package that comprised the FM100 (80-tool) along with a Hahn & Kolb tooling package that included Renishaw probing.

The system achieves an overall positional accuracy of ± 0.001 in, and ± 3 min of arc perpendicular alignment of the main differential bores.

CNC machining: two Yamazaki CNC machine tools have transformed the fortunes of Liquid Systems (1985) of Newport, Wales.

The use of a Slant Turn 40N turning centre and a VQC 20/50B vertical machining centre have cut cycle times by up to 83 per cent compared with conventional machines, reduced setting times, eliminated a number of operations, and improved quality levels.

The company produces a range of flow indication and pump equipment for the coal, atomic power, oil and chemical industries, and takes on the sub-contract machining of shafts and roll blanks, for example.

A major factor in the decision to buy the Yamazaki machines was the Mazatrol programming system, which allows operators to create their part-programs on the shopfloor.

One example of the speed with which part-programs can be produced concerns an aluminium cover plate produced on the VQC. This took 10 minutes to program, compared with at least one hour manually.

Also, a valve body that previously required six operations to complete a series of face and circular milling, drilling and tapping tasks is now machined in one operation on the machining centre. And on the turning centre, a 1 m long shaft is machined in 25 minutes instead of 2 1/2 hours by earlier methods. (Machinery and Production Engineering, 7 January 1987, p.13)

Auto handling in diesel engine manufacture

Lister-Petter's new £1.9 million small turned parts flexible machining system at its Dursley factory has three main features: automated control and supply of bar stock to the six Index four-axis lathes; automated and coded binning and conveyance of parts from the machines to a marshalling area; and a vision-based, non-contact co-ordinate measuring system for routine inspection.

There are currently 160 turned parts up to 200 mm long produced by FMS2. These are small non-proprietary engine components used in the company's 40 sizes of diesel engine (1.5 to 30 HP). All parts are machined from three m long round bar in diameters from eight to 55 mm. Hexagonal and non-ferrous bar have been excluded to help reduce the types and sizes of bar stocked. And rationalization has in numerous cases enabled one bar to be specified for several diameters of component. The result is that the number of bars stocked is 50 instead of 150.

Bar is stored in cassettes in a dedicated one-ton capacity warehouse. Built by Remmert, this has been developed to Lister-Petter's requirements to provide automatic bar selection and the automated transfer of selected bar direct from the warehouse to the machines. Bars coming into the warehouse are chamfered and placed in cassettes in known locations within the store, according to size and material specification. Location is recorded in the Siemens programmbale logic controller (PLC) which has local management of the syste. The PLC is linked to FMS2's controlling IBM series 1 computer, so this also knows the bar store status at any time.

Scheduling of FMS2 operation by the Series 1 computer is influenced by what size and type of bar is loaded into each machine at any one time, as well as by the tooling available. So the work being carried out at a machine will influence the scheduling of bar supply to the machines. The objective is to achieve a 75 per cent system uptime by minimizing machine set-up and bar changes. In practice, it is often possible to finish-machine five or six types of component at one machine from one bar size.

When bar is called from the store it is transported by the store's automatic crane in its cassette to a separator device at the dispensing station. This crane incorporates a Schenk load cell which causes a stock check update to be made every time bars are permanently removed from a cassette. Lister-Petter aims to have this system linked directly to the purchasing department so minimum stock level re-ordering takes place automatically.

At the bar separator there is hydraulically controlled movement of individual bars from the cassette on to a sensor unit which automatically picks the required number of bars. Automatically adjusted guide plates prevent the wrong size of bar being selected. When selecting smaller diameter bars (under 20 mm) a vibrator ensures they do not become interwined. Once selection has taken place, the system goes into reverse so that unwanted bars roll back into their cassette for return to store. A distributor crane with adjustable grippers carries the bars together to the correct lathe.

There is strict control over the movement of finished parts from each machine. As they are parted off they are gripped by the machine's own workhandling unit and transferred into bins which continually circulate on a high level SKF Flex-line conveyor through the system and the machines. On this conveyor the bins and finished parts are carried to a marshalling area at one end of the system, where the number of bins needed to make up a batch are brought together. The conveyor system and the custom-moulded plastic bins were designed in-house. Each bin is coded, and its location and contents are always known by the Series 1.

With each part-program downloaded from the Series 1, the machine tool controller receives instructions telling it how many finished parts are to be loaded into individual bins. Once the quantity, typically 20 to 50, has been reached, the bin is tracked sideways and put into temporary bond. Its place is taken by an empty bin so machining can continue. The bin remains bonded until it receives inspection clearance. When the bin is released, by one of the system's three patrolling operators, it travels on the overhead conveyor to the marshalling yard.

At the time the bin is bonded a sample component is also automatically made available for inspection. The component is taken by an operator to the inspection area at the end of the line, where the View 1200 vision sensing co-ordinate measuring machine (built by View Engineering Inc., US, and supplied by Hahn & Kolb) is located. This is computer-controlled and contains inspection routines for all components produced. The operator simply enters into the computer the component part number and places the component on to a fixture on the table according to instructions which appear on a VDU screen. Because all components are steel, magnetic fixturing can be used to simplify and speed up location.

Instead of a touch probe for measuring a component, View 1200 uses a video camera mounted vertically above the movable table on whcih the component and fixture are mounted and traversed. Accuracy of image definition is ±5 microns or ±2 microns depending on the lens system. Once the operator pushes the 'run' button, the machine is taken through its inspection routine and, at the end of the cycle, determines whether the component is acceptable, also what new offsets may be needed at the lathes to correct for drift.

Because View 1200 operates on stored video, image processing and measurement is done while the table is moving to the next location. This substantially decreases the effective cycle time and increases throughput. According to the manufacturer, processing time averages 100 millisec. Average total cycle time/measurement is 105 millisec plus a table motion time at the rate of 100 mm/sec.

Updating of offsets on the Index machines using the data obtained from the View 1220 data is currently performed manually. The co-ordinate measuring machine is capable of beng interfaced with a wide range of external equipment, and the intention is for offset update to be carried out dynamically. Having been quantified by the View 1200, the offset values would be downloaded to a machine tool control via the Series 1 computer. External details which can be measured on the View 1200 include thread, for which Lister-Petter has had to develop its own software program. A series of points around a thread form is registed by the camera then digitized so that a range of thread details can be calculated.

Lister-Petter chose visual inspection for final inspection because, compared with touch trigger probes, it argues that vision-based techniques offer the advantage of no physical size limitation when measuring fine detail such as threads. Neither is there need for probes to be changed for different routines. Vision's limitation is the inability to inspect internal details, but the company intends to overcome this by using sectioned components. Touch trigger probes are used on the Index lathes, and their operation forms an integral part of the machining cycle for open limit in-process gauging. With these gauges there is automatic dynamic updating of tool offsets. (Machinery and Production Engineering, 18 February 1987, pp. 52-54)

CIM Trends '87

Current trends to computer integrated manufacturing (CIM) can be viewed as the response of the semiconductor industry to the continuing evolution of market demands.

Through the recent history of semi-conductor manufacturing, chipmakers have responded to the need for more functions per die, more functions per unit cost, improved quality of product, and for an ever-growing breadth of product types. These needs have been met by investing in process technology.

For example, to increase the functions per die and reduce the cost per function, semiconductor manufacturers have gone to the latest in scanning- and stepping-projection lithography, ion implantation and chemical vapour deposition equipment. CAD tools, for the simulation of new functions, rapid layout of die and automatic generation of masks and test programs, have enabled manufacturers to bring more complex products to the market, faster.

In other examples of how semiconductor manufacturers have invested recently in new technology, automatic test handling and double testing have been added. A change not so obvious is the implementation of statistical quality control early in the semiconductor manufacturing process to ensure that circuits are within specification when they arrive at the test area.

Much of this "new technology" in semiconductor manufacturing has increased the need for gathering, management and reduction of production and process data.

"Just in time" (JIT) manufacturing, being instituted by systems manufacturers, is the latest market demand that semiconductor manufacturers face.

JIT manufacturing means that a semiconductor manufacturer must ship daily, a specific mix of products to its customers. The customers put these circuits on their assembly floor for immediate use; there is no "safety stock".

We believe that JIT manufacturing will cause major changes in semiconductor fabrication procedures and equipment; a semiconductor manufacturing process will need to be extremely reliable to meet a specific schedule.

Reliability and scheduling are crucial in application specific integrated circuit (ASIC) manufacturing, for example. An ASIC fabrication area can have 50 process flows and 100 circuit types at one time. Each circuit is typically done in low production volumes. The loss o. misscheduling of a single lot of wafers can seriously affect a customer's schedule and the semiconductor manufacturer's business. (Consider: In a 250 step CMOS process, where 50 steps are nonrecoverable and the reliability at each nonrecoverable step is 0.9998 - 1 error in 5,000 lots - probability shows that 1 lot in 100 - 0.9998^{50}, a 1 per cent chance - will not be delivered in time.)

Conventional IC manufacturing has a different, but equally important demand for reliable equipment. The needs are driven by the implementation of new process technologies which are required for new products. Double layer polysilicon processing, for example, is used to reduce die size and improve speed on memories. These new processes must produce high yielding wafers to control cost. Also efficient use of equipment is important to meet cost objectives.

The developing trend to use etched trenches in silicon, for DRAM production, is only one example of how new process technology will continually be implemented to achieve new circuits and enhance performance, driving the need for equipment reliability and efficiency.

Furthermore, in conventional IC manufacturing, test data must be correlated with processing to raise yields and reduce costs.

The 1985-1986 slowdown in semiconductor sales has given semiconductor manufacturers time to address the latest demands for production flexibility and performance. Chip manufacturers are not spending a great deal to expand production capacity, but many are developing CIM programs to improve capabilities.

To achieve flexible manufacturing, semiconductor manufacturers require real-time information about production status and need the capability to direct production to make rapid changes in product, process and schedule.

Production process flexibility must be achieved without loss of quality or yield. This means that process recipes must be loaded into equipment frequently, without error. And each piece of equipment must be reliable enough to do the recipe without error.

A SECS (SEMI Equipment Communications Standard) protocol interface is the accepted way of getting the right recipe to the right wafers at the right time. With SECS and a computer in a piece of process equipment capable of receiving and sending messages, process recipes are co-ordinated with the tracking of work in progress (WIP). The computer in the process equipment also gathers and evaluates all sensor data related to the process. In general, the combination of an equipment computer, SECS and a host computer system form a tool for ensuring the quality of wafer processing, while improving process flexibility.

The SECS interface also plays a part in scheduling equipment - tracking equipment status with the host for co-ordination with WIP movement.

Semiconductor manufacturers are continuing to use terminals with the host computer, to send instructions to operators and to receive information on operator activity. Today the terminal is the primary method used to communicate between the wafer processing floor and the host system. Typically, a host computer sends operator instructions to the terminal on what lot to run based on its tracking of WIP, prioritizing and knowledge of equipment status.

Terminals are favoured because they are flexible and there is long experience in their use. But, as robots are used more for material transfer, the role of the terminal may diminish.

To meet the cycle time demands being placed on them, semiconductor manufacturers are using more work cell concepts - islands of automation. The most common form of work cell today is the lithography cell.

"Continuous flow" wafer processing, so-called sand-in circuits-out, will not function because equipment cannot be made reliable enough. In addition, a continuous line does not meet flexibility requirements. Work cells are the best alternative. They [illegible]ide direct material transfer from one piece of [illegible]t to another, preventing the buildup of inv[illegible]etween equipment. This eliminates much of the [illegible]ing cycle time.

It is significant to note that the processing time of a lot of 25 wafers through a typical lithography cell is about 1 hour versus 8 hours for a conventional lithography area (i.e., separate piece of equipment). The difference in time results from the lack of cassette queues between equipment. (Consider: For a 14 mask-layer circuit, the savings in throughput time with the use of a lithography cell is 98 hours - 7 hours less x 14 layers.)

The relationship between a work cell and CIM is not obvious until cell requirements are examined closely. A cell needs:

- Co-ordination between each piece of equipment;
- WIP tracking, so lot integrity is maintained;
- Equipment status information via an equipment communications interface;
- Highly reliable equipment, including improved equipment intelligence and process sensing.

Despite their advantages and relationship to CIM, work cells are not universally accepted; Japan leads the United States. Reluctant semiconductor manufacturers are concerned about work cell uptime, a product of all equipment uptime in a cell. But more aggressive users trade lower net uptime for lower rework rates and higher yields.

It is also important to realize that a work cell reduces throughput time and can improve quality through rapid process information feedback and control. In a lithography cell, for example, the inspection station sees wafers no later than the throughput time of the system (which is 10 minutes for a single wafer). Thus, any problem can be quickly sensed and the system corrected or shut down before a large queue of missed processed wafers develops.

Further, closed loop control schemes are being developed using the data from lithography inspection stations and the SECS interface, the cell computer and the computer that controls the aligner.

Semiconductor manufacturers can also use data from a work cell at other locations in wafer fabrication. For example, linewidth measurements can be fed to a parametric test system for correlation with MOS transistor characteristics. With the information, the device parameters can be centered by sending information back to the lithography cell to adjust the target linewidth.

SECS is fine for point-to-point equipment communication within a work cell. But a wafer fabrication area with 150 pieces of equipment or 30 cells plus miscellaneous instruments and terminals needs a drop line network, which results in less cabling and an easier interfacing.

Several different drop-line networking systems are being evaluated in semiconductor wafer fabrication areas. These include Ethernet, MAP, collapsed architecture MAP and various proprietary networks. All use a coaxial cable on which equipment communications can be "T'ed" (tied into). The use of a broad-band network, such as MAP, allows the sending of video along with data in the same cable.

Because networking is just starting, the selection of one system by many users has not occurred and will not likely occur for a couple of years.

Ultimately, both SECS and drop-line networks will coexist in the same wafer processing producton area. SECS, because of its low cost and established base, will be used at the equipment level. Drop-line networks, because of their flexibility, will probably be used above the cell level.

Work cells and networking are just starting to be implemented at a few semiconductor manufacturing locations, and typically not at all steps in a process. But if the requirements for computer support of wafer processing operations is viewed from driving market forces, we can estimate future requirements.

The future semiconductor market is influenced by circuits being designed and brought to market now. These circuits include 1M memories, 32-bit processors, voice recognition and synthesis circuits, network interface functions, 20,000-gate arrays, image processing circuits and AI circuits. It seems universal that advanced circuits are larger and more complex, require more masking layers and smaller pattern dimensions than the devices that have preceded them. So, wafer processing will require lower levels of contamination for profitable yields.

Our industry knows how to build clean wafer processing areas, but the operator is still an integral part of the fab process and a large source of contamination. The operator must be separated from the process and the wafers. This means the introduction of fixed and movable transport systems and equipment with a high level of sensing, intelligence and diagnostic capability. Without the operator to assist, the equipment computer will need to pick up that responsibility and diagnose itself, determining if it can continue to do its assigned task defined by the process program.

The added mask layers being run will mean a more complicated set of conditions for the host computer to analyse when scheduling wafer production. Efficient equipment use and fast cycle time will mean additional data being sent from the fab equipment, operators and supply system. As manufacturers become more dependent on the host system for proper operation, the reliability of the host becomes critical. Semiconductor manufacturers are evaluating the use of redundant hosts and data storage systems as ways of keeping the host available.

The addition of transport, robots and more functionality to a host fab system does not lessen the load on the equipment computer, but increases it. In fact, the key to successful automation in a flexible fab line is intelligent, reliable equipment. (Reprinted with permission from Semiconductor International Magazine, January 1987, © 1987 by Cahners Publishing Co., Des Plaines, Il., USA)

STANDARDIZATION AND LEGISLATION

Steps favourable to ISO standards for computer networks

Representatives of the European Community and of MITI from Japan have agreed to strengthen overall acceptance of the open system interconnection (OSI) standard proposed by the International Standards Organization (ISO) and to exchange information on compatibility tests among computer networks. Eight European companies (Bull, ICL, Nixdorf, Olivetti, Philips, Siemens and Stet) have created a centre in Brussels to check whether systems comply with the standards. IBM, which has its own SNA network architecture, with a view to making its equipment compatible with OSI standards, has launched two software products intended for computers of the 370 range. At the same time it is permitting that software companies access, free of charge via teleprocess. The OSI software verification service installed in the centre it has in La Gaude (France). It has also announced that it will install a centre in Rome for the development of specialized software for adaptation to OSI standards.

The ISO model has the support of European industry and of COS (Corporation for Open Systems) formed by 56 USA informatics and telecommunications companies. By the same token, General Motors is adapting its Manufacturing Automation Protocol (MAP). (Bulletin IBIPRESS, No. 108, 23 November 1986)

Standards published for small computer system interfaces and robots

Standards concerning the use of industrial robots and small computer system interfaces have been published recently by the American National Standards Institute.

The industrial robot standard takes into consideration that people have to work in the range of the programmed movements of the robot. The standard, ANSI/RIA R15.06-1986, requires manufacturers to design and construct robots so that they do not move faster than 10 in. per second. It also stipulates that this speed be used for all programming, maintenance and repair tasks while workers are in close contact with the robot.

Manufacturers are required to eliminate potential hazards from moving parts, sources of energy, component malfunction, power loss, electromagnetic and radio interference and other causes.

The standard calls for controls to be constructed or located so as to prevent their unintentional operation to protect workers from unexpected robot movement. A hardware-based emergency power switch overriding all other robot controls is prescribed.

Perimeter guards which prevent workers from entering the robot's work envelope is another requirement. Presence sensing devices and interlocked access gates, which quickly stop robot motion, are specified in the standard.

Other provisions call for training operators, robot teachers and maintenance and repair personnel in safe procedures.

The standard was developed and processed for submittal to ANSI by the Robotic Industries Association.

The standard for small computer system interface (SCSI), ANSI X3.131-1986, is intended to make it easier and less costly to integrate small computers and intelligent peripheral devices into mini- and microcomputer systems.

The SCSI standard establishes mechanical, electrical and functional requirements for an 8-bit parallel bus interface and command sets for peripheral device types. The specified command sets are device-dependent to facilitate development of software that can control all devices of a particular type, regardless of manufacturer. Different disk drives, printers and even communications peripherals can be added to the small computer system without modifying generic software or hardware.

A dramatic growth in the number of types of storage devices in the early 1980s - particularly the emergence of the physically small, high-capacity/high performance fixed medium magnetic disk drive - stimulated development of small computers and created an urgent need for an interface standard.

The interface described in the standard can be operated at moderately high data transfer rates up to four megabytes per second. It is suitable for use in large-scale integration circuitry employing inexpensive drivers, receivers, cables and connectors. The standard provides for interconnection of as many as eight peripheral devices and use of cable lengths up to 25 meters.

In a section on logical characteristics of the interface, the standard provides for an arbitration option to permit multiple initiators and concurrent input-output operations. It requires all SCSI devices to be capable of operating with the defined asynchronous transfer protocol. An optional synchronous transfer protocol is provided.

Other sections specify the SCSI command structure, commands that have consistent meaning for all device types, and device-specific commands. These include commands for direct-access (magnetic disk), sequential-access (magnetic tape), printer, processor, write-once-read-multiple (optical disk) and read-only direct access devices.

Several appendixes provide examples of SCSI signal sequences, timing and phase sequences.

Copies of the SCSI standard, ANSI X3.131-1986, are available from ANSI for $25 each. Copies of the industrial robot standard ANSI/RIA R15.06-1986 are available at $7 each. Contact ANSI, 1430 Broadway, New York, NY 10018. (Industrial Engineering, December 1986, p. 4. Reprinted with permission from Industrial Engineering magazine © Institute of Industrial Engineers, 25 Technology Park/Atlanta, Norcross, CA 30092)

AT&T works with users on Unix

UK Unix users are working in co-operation with AT&T - developer of Unix - to create a universal standard for the operating system. AT&T representatives joined Unix users and suppliers at a meeting in London, to draw up a list of recommendations for a Unix standard.

The impetus has come from the Information Technology Users' Standards Association (Itusa). To help raise the money to research what Unix users want as a standard, Itusa has applied for a grant from the EEC. The application has been "well received", but no decision will be taken until early next year.

Meanwhile, AT&T is weathering the user criticism that arose after it announced Release 3 of System V this summer.

With the licence agreement for Release 3 AT&T introduced the constraint that any Unix system must conform to its System V Interface Definition manual by being tested against its System V Verification Suite software. (Computer Weekly, 11 December 1986, p. 1)

US, Europe seek software link

Leading computer manufacturers have met recently to decide on a standard operating system. The new standard, called Posix, the portable operating system for computer environments, will make it possible to run the same applications software on the computers of a variety of manufacturers.

The Posix standard has been developed at the IEEE, the Institute for Electrical and Electronic Engineers in the US. The IEEE, an association which is independent of suppliers, has obtained the support of more than 50 computer manufacturers for the project. Posix is essentially a Unix operating system to which new functions have been added. It can be used on a large range of computers.

ATT, Digital Equipment, Hewlett Packard, and IBM of the US and Bull, ICL, Nixdorf, Olivetti, Philips, and Siemens of Europe sent representatives to the recent meeting, which took place in Washington. These manufacturers have become aware of the pressing need to develop a standard in the software environment. (Bulletin IBIPRESS, No. 115, 8 February 1987)

Nineteen unite to watch for crime

Nineteen of the world's largest companies, including IBM, are presenting a joint front against computer crime.

They are the first members of a new worldwide body for protecting corporate information called the International Information Integrity Institute.

Security expert Donn Parker, known as the "bald eagle" of computer crime, is behind the institute and last week addressed user groups, banks and manufacturing companies in England, France and Italy in a bid to sign further members.

His message: "You must have the controls and practices that everybody else has in your industry. If you don't, you are deficient and could be accused of negligence."

The institute is run by the Stanford Research Institute (SRI International) and offers forums, reports and on-site clinics in return for a $19,000 membership fee.

Huge US companies including Sears Roebuck, the Bank of America and IBM have already helped in the planning stages. Now the group wants at least five European companies to join in 1987.

"The purpose is to get manufacturers and users meeting on neutral ground," says Parker. (Computer Weekly, 18 December 1986, p. 1)

Euro Commission sets five-year plan

The European Commission has published its new five-year computer strategy, setting out its commitment to open systems and multivendor hardware purchasing.

The first five-year plan, drawn up in 1981, laid the groundwork for multivendor procurement and the Commission's support of international standards such as the X/Open Unix portability guide.

The new strategy, covering 1986 to 1991, gives technical guidelines for implementing standards both in the Commission and in the various European institutions with which it deals. The Commission is adopting Open Systems Interconnection standards for all communication between different equipment and institutions.

The document outlines the Informatics Directorate's plans to computerize the flow of information around the member countries. These plans include the Insen electronic mail project and Insis, which will computerize the transmission of the 300,000 documents sent out annually by the Commission.

The Informatics Directorate has an annual budget of over £36.5 million to provide computer facilities for the commission's 12,000 staff. Its Luxembourg computer centre houses Amdhal, ICL, Bull and Siemens kit. (Computer Weekly, 8 January 1987, p. 2)

Latin American meeting on the legal protection and sale of software

Latin American institutions have met in Argentina to resolve questions regarding the sale and legal protection of software. The meeting was held under the auspices of Argentina's Undersecretariat of Informatics, Calai (the conference of Latin American Informatics authorities) and Crealc (the regional centre of IBI for the Latin American and Caribbean countries).

The cue with regard to software sales was taken from the main characteristics of the market in Argentina, Colombia and Mexico. This analysis made it possible to study mechanisms capable of promoting the advance of the market in the region. Among the political steps and instruments proposed, stress was placed on financial incentives and the utilization of the State's purchasing and contracting power in order, in the short term, to develop specific applications and, in the medium term, generic and parameterized software.

Within the scope of the study on the sector's promotion policies, the need was maintained to establish a juridical system that includes a way to protect software. It was also stated that, despite certain comparative advantages for the development of this sector in the region, there are nevertheless difficulties that must be overcome, such as the large capital investments required and the barriers existing with regard to commercial and technological transfers. There was consensus in acknowledging that the technology transfer systems being used in Latin America are unsuitable for regulating international contracts on software-use licenses, for which reason it would be convenient to establish registers or other appropriate systems.

The study of the contract types on the software market has made it possible to identify three types: the purchase-sale, widespread in the field of programs for the microinformatics product, the use license, which comprises standard basic application software intended specially for medium-sized and large installations, and contracting by individual users for development according to specific applications.

As far as the structuring of the legal protection system most adequate to the characteristics of the software in Latin American countries is concerned, two trends were seen to emerge: one proposed to adjust to the property laws in force to regulate and protect software - the other held that, in view of the specific nature of software and the appraisal of the international market's peculiarities, specific regulations must be applied.

Although it was agreed that such structuring must be realized within the scope of the overall legislation on informatics programs, the debate continues on aspects such as access to source codes, the problem of duplications and the characteristics that a software register must have.

The Argentinian Undersecretary of Informatics and Development, Mr. Correa, presented a tentative plan of a specific protection system which refers to the law and conventions that protect authors' rights, places domestic and foreign software production rights on the same level by giving them a lifetime of 15 years, stipulates the need to register computer programs and includes the institution of a licence that would be compulsory in certain circumstances, as well as the utilization of the registered software when it is declared to be in the national interest.

Finally, considering the importance for the various criteria, in the establishment of the legislative guidelines, of Latin American countries to coincide, it was urged that the tentative plan be sent to various bodies in the region in order to bring about an ample exchange of ideas. (Bulletin IBIPRESS, No. 110, 7 December 1986)

RECENT PUBLICATIONS

UNIDO publications:

IPCT.15 (SPEC)	Strengthening Negotiating Capabilities in the Acquisition of Hardware and Software in Latin America prepared by S. Soltysinski
PPD.4(Limitada)	Implicaciones de la nueva revolución industrial: nuevas tecnologias de información y su impacto sobre las estrategias de industrialización Prepared by the Secretariat for a seminar on Nueva Estrategia de Industrializacion en Colombia organized by the Fundación Nueva Colombia Industrial and held in Bogotá in July 1986.
PPD.5	The impact of expert systems prepared by the secretariat

The UNIDO secretariat is planning to publish a directory of institutions in the field of information technology for development which will provide inter alia information on functions, resources and services available such as training courses. It is hoped that such a directory will be especially useful for our readers in developing countries and as a matter of fact, suggestions to compile information on training courses etc. have been received from our readers. Contributions to the proposed directory are welcome.

Union reaction to high tech

Most workers support the introduction of new technology into the workplace, according to a new study entitled Workplace Industrial Relations and Technical Change.

The report's author, Bill Daniel, is director of the (UK) Policy Studies Institute. He said: "Far from provoking resistance, advanced technology has served as the sugar coating around unpalatable organizational changes enabling workers and unions to swallow the types of more productive working practice that used to have to be forced-fed."

The report, released in January 1987, looks at the reaction to change in some 2,000 workplaces, taken from the accounts of managers, shop-stewards and manual workers.

The study uses the introduction of new microelectronics technology as the focal point of a 1984 workplace survey and said that where industry does fail to innovate it is often managers who are resistant to change. Indeed, overseas managers in Britain have a better track-record for change than their domestic counterparts.

The survey asked managers and shop-stewards whether they had experienced each of the following three types of workplace change in the last three years.

- Organizational change - change in working practices such as changes in shift work patterns.
- Conventional technical change - change involving non-microelectronics based plants.
- Advanced technical change - change involving microtechnology.

Daniel found, contrary to his expectations, that both types of technical change were far more popular than organizational change regardless of implications for pay and job security.

The study established organizational changes to be more likely to result in short-term loss of jobs than technical change. However, support for technical change remained strong where the implications for jobs were the same.

"More strikingly we found that support for technical change in instances where the number of jobs was declining was stronger than that for organizational change in a climate of expanding employment," Daniel said.

Technical change, the study said, is associated with better pay and an increased level of skill, responsibility and intrinsic interest in the job. Indeed, where new technology leads to a reduction in jobs the workers involved in the introduction are insulated from this effect.

"The costs of the job losses are experienced by those seeking to enter employment - the unemployed and those who are leaving full-time education or seeking to return to work after an absence from the labour market," Daniel commented.

Despite this evidence there remains a myth of worker resistance to technical change. Daniel said this is because those most reluctant to change are large manufacturing plants and nationalized industries, such as British Rail or the Post Office. These companies tend to catch the headlines and hence perpetrate the myth.

Daniel said some labour researchers tend to promote the idea of resistance because they feel that some workers are too quick to accept change without ensuring their interests are adequately protected. (Reviewed in Electronics Weekly, 10 December 1986)

The robots take their time

The rise of industrial robots is irresistible and irreversible. They are steadily getting better and, at the same time, they are getting cheaper. But the much-heralded robot revolution is proceeding at a far slower pace than predicted. This offers an opportunity to brace for a brave new world in manufacturing, according to a study published by the International Labour Office (ILO).*

During this decade, the robot population in major Western advanced countries is likely to triple and even quintuple. Projections show that by 1990 the number of robots will reach 70,000 in Japan, 60,000 in the US and 25,000 in Sweden and the UK, followed closely by France. Similar growth rates are foreseen in the advanced socialist countries, where a

* "The impact of industrial robotics on the world of work", by Karl H. Ebel, published in the International Labour Review, Vol. 125, No. 1, 1986. (See also Monitor No. 19.)

total of 200,000 robots is expected to be at work in the early 1990s, mainly in the USSR, Czechoslovakia and the GDR.

As with all new ventures, however, robotization can be a risky business and often fails to bring the expected benefits and results. "Production management beginning to respond more cautiously to the engineering researchers' vision of the promised land," the study notes.

Thus Volkswagen - the main user user of robots in the Federal Republic of Germany - prudently devotes only 4 to 7 per cent of investment funds to robotization.

A British survey found that 44 per cent of firms which started to use robots met with initial failure and 22 per cent abandoned them altogether, mainly because of inadequate technological know-how and skills at all plant levels.

In the USSR, Pravda reported that many industrial robots remain in warehouses and that supply far exceeds demand because of resistance to robots caused at least partially by their low reliability and by installation problems.

This much said, robotization is by and large a viable proposition. The machines can work round the clock, raise output, product quality and industrial competitiveness. One robot can replace between two and five production workers, while providing cheaper labour. In the US car industry, a man-hour costs around US$23 - a robot-hour costs only $6.

Certain jobs, mostly simple or hazardous ones, are irretrievably lost to robotics. Thus spot welders, press operators, spray painters, cleaners, machine loaders, and grinding and polishing machine operators are endangered species.

But what is the alternative? In today's competitive world the obsolescence of industrial equipment spells the decline of an undertaking. This is a far more serious threat to all jobs than robotization.

Morevoer, there seems to be no correlation between high unemployment rates and the use of robots. Consider Western Europe with relatively few robots and very high unemployment, and Japan where the robot population is the largest and joblessness the lowest of all OECD countries.

All this, of course, is cold comfort to workers whose jobs are threatened. To alleviate their predicament a number of measures can be taken at the enterprise level. Among them, marketing of new products and services, expansion of production through a better competitive position, retraining and further training of workers, and early retirement.

Robots must be put on the bargaining table. Genuine and timely consultations should be held on robotization between management and labour. Workers and their representatives have to be kept fully in the picture about impending robotization before it happens, and not after as is often the case.

"Both sides have a stake in innovation, and that of the workers needs to be fully recognized and taken into account," the study points out. "The inevitable social and labour problems brought about by robotics will best be overcome in an atmosphere of mutual confidence and understanding in which workers are not victimized through decisions disregarding their legitimate interests in jobs, income, training, working conditions, work organization and occupational safety and health.

"There needs to be a commitment of the workforce to technical change, and co-operation between management and shop floor is crucial to success. Rigid insistence on management prerogatives could only be counterproductive," the study warns.

"Robotization cannot be done without people and it must finally serve people," it concludes. "Only when innovation improves the lot of the humans involved will it be accepted." (Reviewed in Development Forum, November/December 1986)

Only the rich have robots

While robots are successful in the few UK companies which have them, the Government must bring back its support grants if UK firms are to exploit robots to the same extent as their overseas competitors.

This is the conclusion of a new government-funded study by the independent Policy Studies Institute.* It shows that 740 firms in the UK have robots - less than one factory in 40.

The total number in use at the start of the year, around 3,200, was less than the increase alone in 1985 in the Federal Republic of Germany. The installation rate has since tailed off as the government support scheme has ended.

The number of robots and user companies took off in the early 1980s, when the Government introduced grants covering a third of the cost of buying systems, the survey shows.

It says that if there had been no grants there would have been 450 - just over 14 per cent - fewer robots in use today.

Almost half the users questioned had had grants. Of these, 50 per cent said they would not have introduced any robots without the grants, 25 per cent said their plans would have been delayed and 25 per cent said they would have gone ahead on a smaller scale.

"The support scheme made a crucial impact on investment decisions and its removal may have a drastic effect," the study comments.

The biggest obstacles to the introduction of robots were found to be financial, with the next group related to technical expertise.

"The shortage of production engineers with expertise in advanced manufacturing technology is a crucial point of weakness," says the study. "More are urgently needed and provision of relevant courses in higher education needs to be expanded."

Of the companies using robots, 81 per cent said they were worthwhile and only 3 per cent believed they were not.

Employee resistance was feared by 31 per cent of firms before robots were installed, but only 2 per cent encountered any when the systems came in.

Indeed, 71 per cent said employees had favourable attitudes towards robots and 17 per cent said labour relations improved when robots were introduced.

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* Robotics in British Industry: Expectations and Experience. 234 pp. £39.95. Policy Studies Institute, 100 Park Village East, London NW1 3SR.

The study is hailed as "optimistic" by Michael Kelly, chairman of the British Robot Association, which sparked off the survey. "The challenge now is to get the benefits to people who don't have them," he says. "It's up to all of us: to the industry to spread the word, to the financial community to understand that the pay-back on advanced manufacturing technology is three or four years - and to government to continue with its support schemes. We must make it clear to industry that if the UK is to survive we must change our attitudes."

An advanced robotics research centre is being set up by the Department of Trade and Industry with two dozen industrial partners.

The department will part-fund the scheme for three to five years and is choosing one of 10 companies and other organizations which have offered to be the host site.

The centre will do research into advanced manipulators and sensors. (Reviewed in Computer Weekly, 6 November 1986, p. 6)

Growth in number of robots users and robots in UK

	Robot users		Robots	
Year	No. at start of year	Annual change	No. at start of year	Annual change
1981	100		371	
1982	150	+50%	713	+92%
1983	220	+47%	1 152	+62%
1984	350	+59%	1 753	+52%
1985	580	+60%	2 623	+50%
1986	740	+32%	3 208	+22%

Source: BRA Robot Facts, Policy Studies Institute.

Bulletin on Informatics published in Argentina

The Secretaria Permanente de la IX Conferencia de Autoridades Latinoamericanas de Informatica Argentina (SPCALAI), Suipacha 760 - Piso 5° - Of. 29, (1008) Buenos Aires, Argentina, pubishes a bi-monthly newsletter, Boletin Informativo de la SPCALAI, dealing specifically with developments in informatics and regional co-operation in Latin America.

Resources in development journalism

A directory of development journalists and new resources has been compiled under the auspices of Development Forum, a publication of the United Nations Division for Economic and Social Information/DPI and United Nations University. Its contents include journalists' names by country of residence; grids giving journalists' names according to regions and subjects they write about; and lists of journalists' professional qualifications and abilities, journalism professional associations, schools of journalism and mass communications, radio stations carrying social and economic programming, and development-oriented news/feature services and news agencies. Lists of information services of the United Nations system and of United Nations information centres also are included. (Price US$20).

Requests should be addressed to Directory Sales; Development Forum; Room DCL-562; United Nations; New York, NY 10017, USA.

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