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DESIGN TECHNOLOGY TRENDS
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TO OUR READERS

Already in the 1960s computers were recognized as tools that would change the design process in many branches of industry. The essential advantage of computer design is its tremendous versatility achieved at negligible cost. Nowadays computer design has become indispensable for competitiveness. With the present globalization, this means that no company, either in industrialized or developing countries, can really be competitive without the support of computers for product design.

In this issue of the *Microelectronics Monitor*, the special article is on this subject. The designs discussed include engineering design, drug design, architectural design, dress design, electronic circuit design, as well as software design. The paper has been prepared by a professor of technology management from India, and presents the question of design from a developing country perspective. The automation of design is one of many forms of improving competitiveness through the application of information technology. Another crucial one, is the improvement of management performance. To that end UNIDO is implementing the project XA/RAF/94/633 "Improvement of Management Performance through the Applications of Computers and Training for SMEs (IMPACT)".

During the period 11–15 December 1995, the IMPACT Unit at the African Regional Centre for Technology (ARCT), in collaboration with UNIDO, organized the Regional Workshop on Reengineering in Small- and Medium-Sized Enterprises through the Application of Computers and Training. The workshop was held in Dakar, Senegal, in conjunction with the AFRISTECH 95 conference. The main objectives of the workshop were to present the IMPACT strategy and to demonstrate the IMPACT components to participants from the region, to discuss the applicability and usefulness of IMPACT to small and medium enterprises, and to elaborate a strategy for its further dissemination in the region. All the objectives were achieved, and the participants from Kenya, Ghana and Zimbabwe expressed their interest and desire to have IMPACT implemented in their respective countries as soon as possible, as it was considered to be a vital tool in the process of strengthening SME performance and competitiveness.

It was furthermore agreed that IMPACT should be introduced as a vehicle for business reengineering, thereby giving support organizations the opportunity of close cooperation with individual SMEs during the reengineering process. It is assumed that sustained improvements are more likely if support is provided for a period.

Adaptation of the 3B and PHAROS software packages will require some additional work before becoming operational. However, it should be possible to use the IMPACT management training course immediately after completion. It was thus agreed that the training course can be disseminated to the countries after a training-the-trainer session, and serve as a vehicle to attract interest for IMPACT among local small- and medium-sized enterprises. In addition, the training courses can be offered for a fee, which should bring some funds to the national counterpart institutions to be used for the local adaptation of the IMPACT software, as appropriate.

Konrad Fialkowski
Scientific Editor

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A. SPECIAL ARTICLE

DESIGN TECHNOLOGY TRENDS AND COMPETITIVENESS

by B. Bowonder

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Introduction

World class manufacturing is no longer sufficient to remain competitive, and world class product development is emerging as the next competitive frontier.[1] Design is the crucial step which can provide a competitive edge in the manufacturing cycle. Among the competitors, all other factors are evenly matched. Developing countries which do not have indigenous design capabilities, may find the inadequacy in design capabilities a serious handicap in becoming integrated with the global economy. Even in traditional industries, such as textiles, leather, carpets and gems, new design technologies are making inroads. In service industries also, innovation and new design are becoming the key to competitiveness. Hence, without design competence industrial trading advantages may not be long lasting. The cost of the design step for many of the industrial products may be as low as 5 per cent of the total manufacturing expenses, but it determines 70 to 80 per cent of the manufacturing cost.[2] This article is an attempt to examine the design technology trends and their implications for competitiveness in the present context. This article covers design from a broader perspective, and encompasses fields such as engineering design, drug design, architectural design, dress design, electronic circuit design, as well as software design.

Competitive context

Technology driven competition is shortening the product life cycle.[3] Because of this, the idea to market cycle time is becoming compressed. Many executives have recognized the significance of response time as a competitive weapon, but are struggling to achieve world class speed. The first major competitive demand today is to reduce or compress the idea of manufacturing to market cycle. At the same time, the emerging requirements of total quality management and ISO 9000 demand that the design be error free in the shortest possible time. Similarly, because of competitive pressures, the cost and performance need to be better balanced. The three simultaneous demands on the designers are:

- Shorten the new product realization time.
- Conform to stringent quality norms, and
- Minimize the cost.

These require that the designer considers these aspects from the start and integrates the conflicting requirements before the finalization of design.

A design engineer is presented with a technical problem or need and the ultimate aim is the conversion of this into the information from which something can be manufactured at a high enough quality and low enough cost to overcome the problem or to meet the need.[4] Design is a multifunctional team activity and hence the success of design will depend on communication and information

exchange. By realizing the importance of design, manufacturing and service, organizations are using advances in information technology to facilitate information exchange and communication. The design technology trends have to be seen in the context of the emerging information-communication revolution.[5]

Design technology trends

Design is the process of converting an idea or market need into detailed information from which a product or technical system can be produced.[1] The design can be conceived as a process consisting of five generic processes, namely:

- Design concept formation,
- Conceptual design,
- Detailed design,
- Prototyping, and
- Manufacturing.

Pugh considers total design.[6] as a cycle consisting of:

- Market need identification,
- Product specification,
- Concept design,
- Detailed design,
- Manufacturing, and
- Marketing.

Currently the emphasis is on total design. The generic processes involved in realizing a design have been termed as:

- Integrated product development,
- Fast cycle time,
- New product realization, and
- Team design.

The advances in information technology have provided a variety of enabling technologies for the realization of new product development. The new major technologies which facilitate in realizing a new product can be identified as (a) digitization of design; (b) collaborative design; (c) virtual design; and (d) concurrent design.

(a) **Digitization of design:** This allows for better specification of design inputs and design outputs. Computer aided design, along with engineering analysis software, allows the testing of designs rapidly and the making of changes rapidly. The quality of design will depend on the group processes which get into the first design step, namely, the concept formation. This is the most important step in a design process. The initial step in design is more intuitive and experience based.[7] This step involves intuition, reflection, imagination and expression, as shown in figure 1. To realize the concept formation one would like to have a creative and expressive organizational culture. In other words, realization of design has a behavioural and organizational dimension. Any competence

Figure 1. Evolution of design

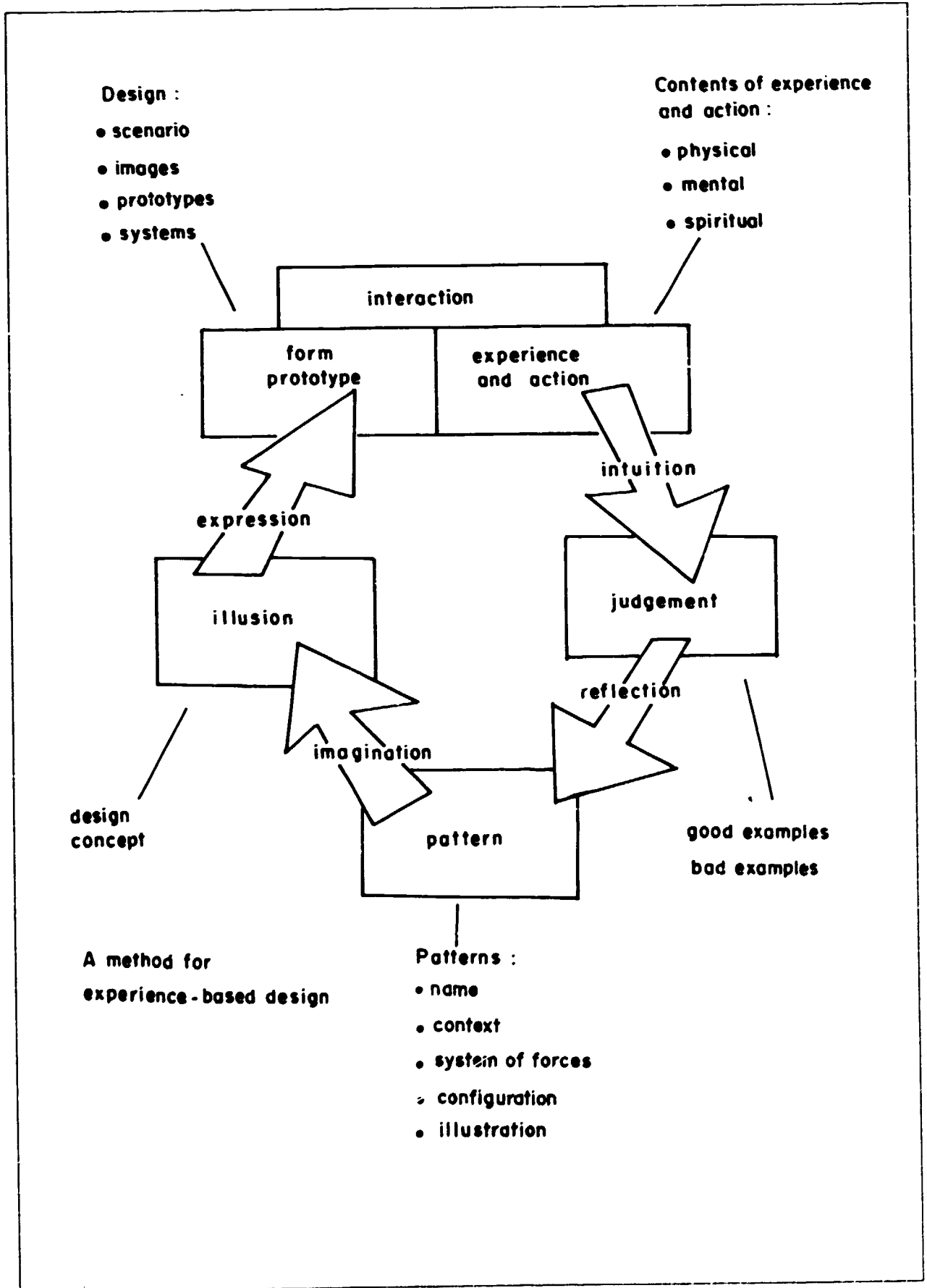
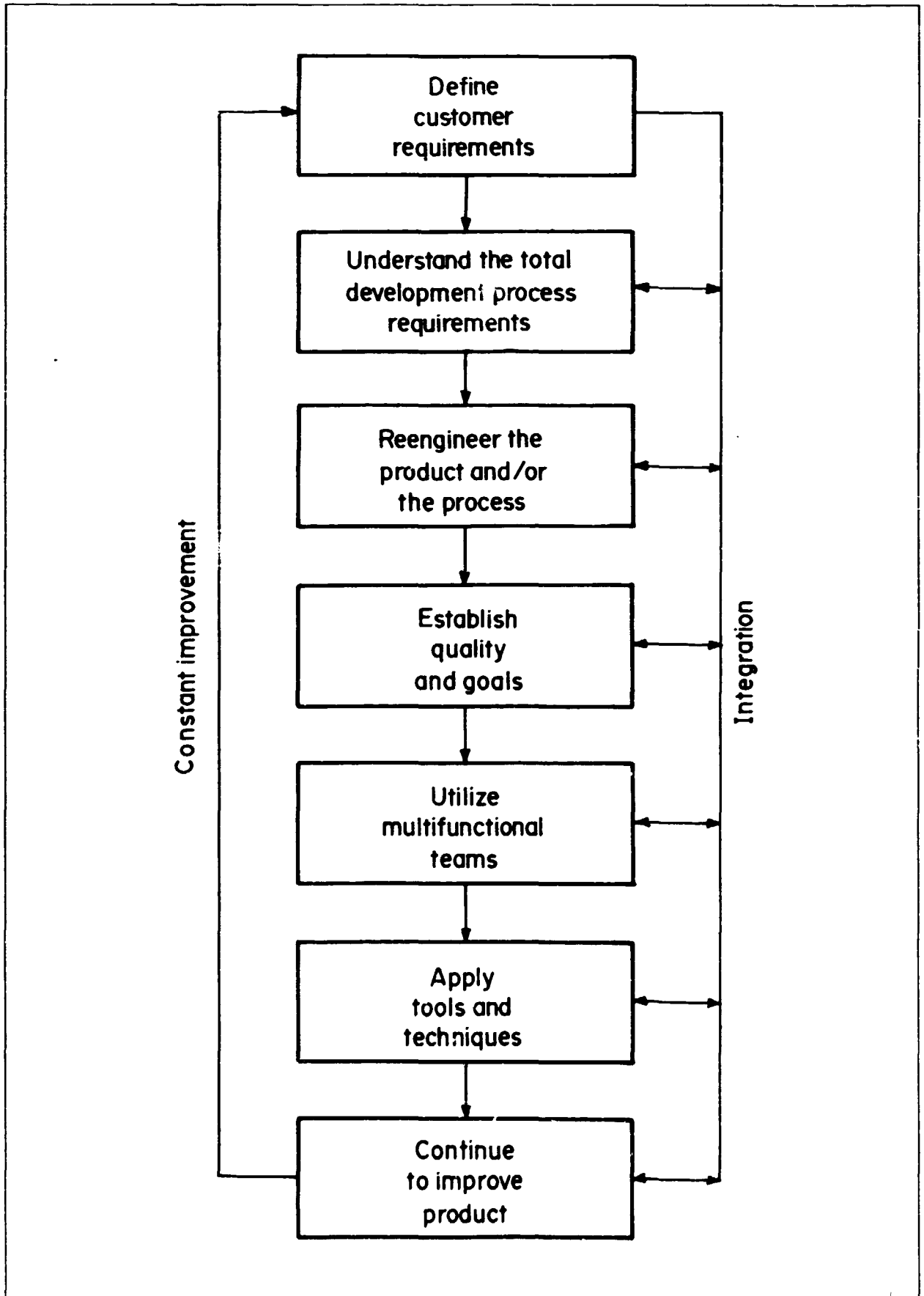


Figure 2. Design process integration



building process focused on design has to address both these dimensions apart from any technological modernization. The design process integration is schematically presented in figure 2.

(b) Collaborative design: Computer supported cooperative work (CSCW) means facilitating interactive and collaborative design. CSCW is a system that integrates information processing and communication activities to help design group members work together as a group, using user friendly software, standardized terms and protocols to handle interactions between multiple tasks performed by multiple groups.[8] The evolution of CSCW is schematically presented in figure 3. Computer supported cooperative work is being used by film and TV producers. Real time communication using computers is helping visual professionals such as film producers and industrial as well as architectural designers to carry out concept and product planning. CSCW requires an inter-disciplinary approach from the earliest stages, involving academic researchers in visual communications and human factors, as well as software engineers. Working visually is a new paradigm to many professionals in fields such as architectural design, film art, interior decoration, museum organization, as well as machine or electronic circuit design. Awareness of and ability to work with images or visual thinking is the critical capability needed in the present context. Conventional design teams lack visually trained professionals who can articulate user requirements. Visualizing the unknown and unseen is becoming the basis for innovative design. Using cooperative work systems, experts are able to conceptualize the design jointly and derive alternative designs.

(c) Virtual design: Virtual reality is facilitating conceptual design. Computer generated 3D images, along with immersive techniques, are helping designers to conceptualize hospital interiors, aircraft interiors, kitchen layouts, complicated system couplings in machines, textile colour combinations, molecular interactions for drug design, surgical interventions in the form of digital surgery, etc. Boeing Co. used virtual reality for the conceptual design of the interior of the B-777, which became operational in June 1995. Virtual reality will revolutionize the design conceptualization process, along with the advances in visualization and animation. Innovations are often driven by a combination of technology advances and application demands. Swift advances in computer hardware—particularly faster, larger and cheaper memories—have been transforming revolutionary approaches in computer graphics into reality.[9] Visualization helps in generating representations from data sets through the use of interactive graphics and imaging.[9] User friendly software is making this possible for a variety of situations.

(d) Concurrent design: Concurrent engineering or concurrent design, can be defined as an emerging design philosophy which systematically incorporates planning for all phases of the project life at its very inception. Concurrent engineering is a culture in which all functional experts from all phases of the life cycle play an active role in realizing the concept. Concurrent engineering is an integrated product development procedure which ensures better functional coordination, lower failure rates, lower rework and rapid trouble free design implementation.

Implementing concurrent engineering requires the use of multidisciplinary or interdisciplinary teams. Customers and suppliers are also invited as team members, so that real time feedback can be obtained from them.[10] Chrysler, Boeing, Honda, Toyota, Nissan, etc., are some of the engineering firms which have benefited immensely from the use of concurrent engineering.[11] Shorter new product realization has been achieved by the following:

- Customer involvement in the initial stages of design,
- Preparing multiple prototypes,
- Functional coordination,
- Vendor development along with design,
- Structural evaluation and fault analysis in the early phase of design, and
- Using a common CAD and CAM protocol, which facilitates easy transfer.

The concept of concurrent engineering is schematically presented in figure 4, along with the traditional or sequential engineering. Competition will further shorten the product realization time. Advances in information technology are making concurrent design easier and affordable, even for small- and medium-sized firms.

Design and manufacturing integration

One of the major trends driving the design process is the easy transferability of design to the manufacturing phase through a common protocol. The integration of design and manufacturing has been made possible through a variety of techniques or procedures, most of which are being widely used by innovative firms all over the world.

Rapid Prototyping: Rapid prototyping involves the direct generation of physical objects from graphical computer data. Rapid prototyping and manufacturing can be used to increase competitiveness in virtually any industry, from the aerospace to the medical. It is well suited for producing prototype components and products as diverse as rocket thruster gimbals, hip implants, rocket intake manifolds, automobile distributor bodies, centrifugal compressor wheels, etc. The basis of rapid prototyping is "stereolithography". The Chrysler Corporation first began rapid prototyping in 1989 through the use of stereolithography, and the results were so promising in terms of cost saving, time saving and improved quality, that they never looked back.[12] Chrysler Corp. leads the automotive industry in the application of stereolithography. The basis of rapid prototyping is "one real prototype is worth a thousand pictures". The steps involved in rapid prototyping and integrating it with manufacturing are:

- Design the prototype on CAD,
- Build the prototype with rapid prototyping equipment,
- Inspect the rapid prototyped part for errors,
- Correct the errors in CAD,
- Verify the corrected rapid prototyped part,
- Iterate, using rapid prototyping equipment to improve the design
- Optimize by testing multiple rapid prototyped design variations
- Fabricate a functional test model utilizing the rapid prototype
- Perform functional testing on the functional test model, and
- After final approval, proceed to manufacture.

Figure 3. Evolution computer — supported cooperative work and groupware

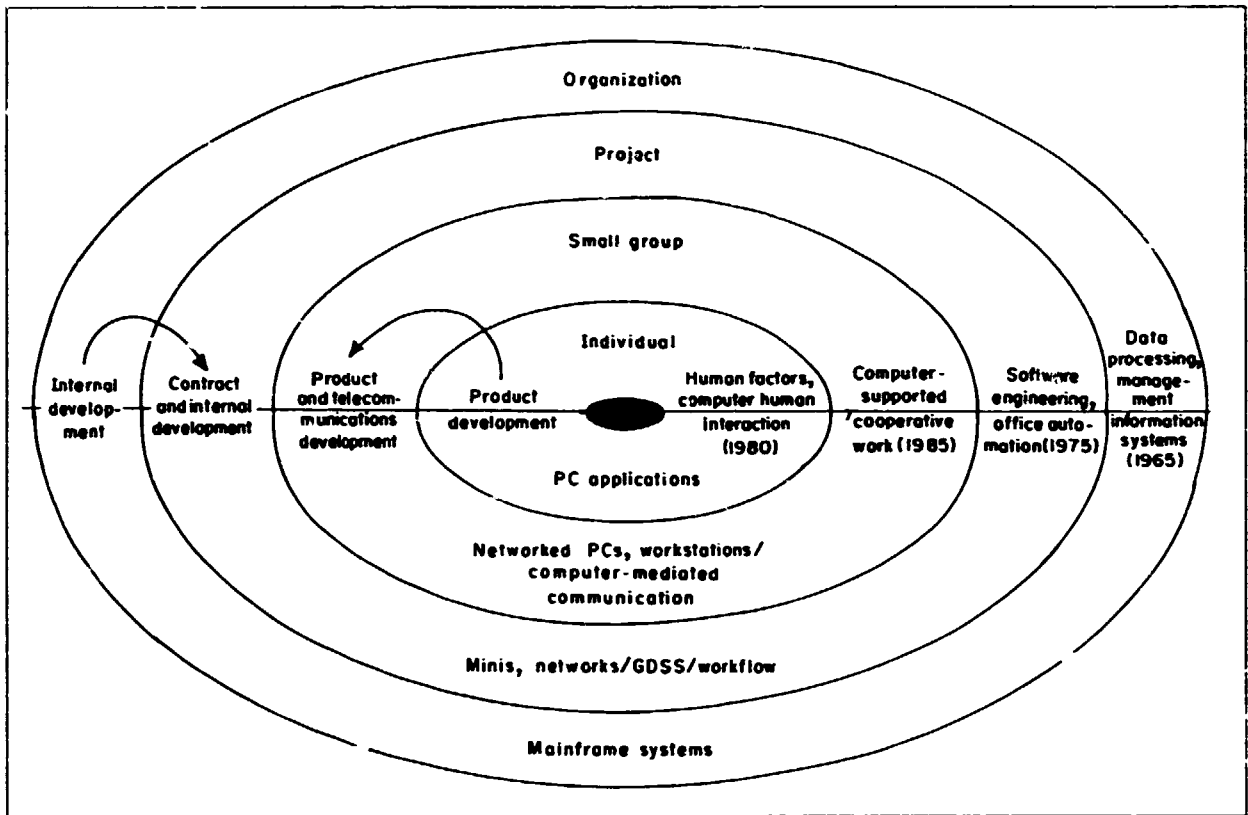
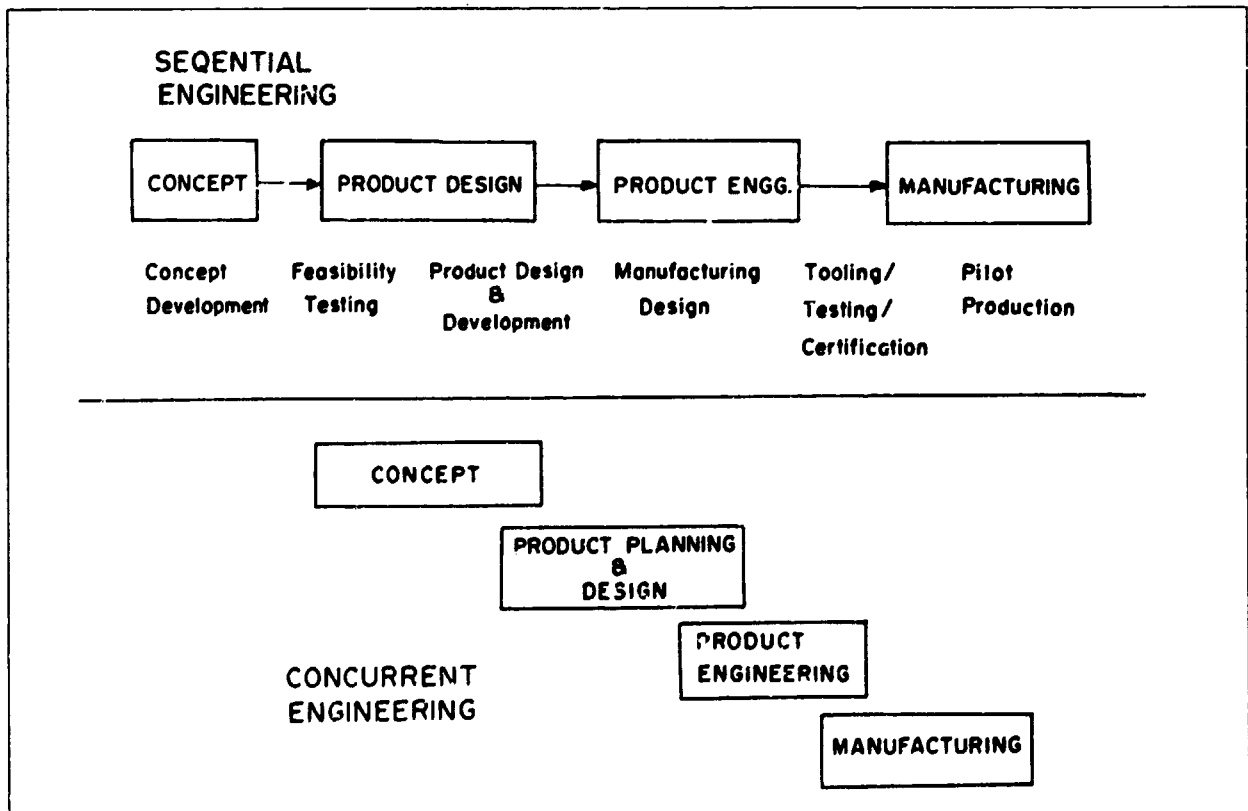


Figure 4. New product realization



A number of global industries are already using the technology. By using rapid prototyping, designers have been able to detect product flaws early in the design process and to iterate and optimize a design at reduced cost relative to traditional methods.

Design for manufacturability and assembly: Product design plays an important role in determining the cost and quality, and thus the effective life of a product.[13] The sequential nature of product design and manufacturing process implementation prevents the integration of product and process design. Product designs often get thrown "over the wall" by designers leaving the responsibility of building the products to manufacturing engineers.[13] Although the actual cost of design may be a small proportion of the cost of manufacturing, 70 to 80 per cent of the manufacturing costs are determined in the design phase. Design for manufacturability and assembly attempts to ensure that the designed product can be fabricated and assembled without substantial cost or quality penalties. Design for manufacturability (DFM) is an approach to design that fosters simultaneous involvement of product design as well as manufacturing process design. DFM aims to produce a design at competitive cost by improving its manufacturability without affecting its functional and performance objectives. Design for assembly (DFA) attempts to develop a quality product at the lowest cost by eliminating unnecessary parts and by refining geometrical considerations to facilitate quicker assembly of the product during the manufacturing cycle. The design for manufacturability and assembly aims at optimization of product and process concepts during the design phase of a product in order to ensure ease of manufacture, including assembly.[14] The tools used for facilitating better manufacturability are:

- **Axiomatic approach:** This aims at optimization of manufacturing systems through the application of good design principles or axioms.
- **Taguchi method:** This method attempts to achieve robust design through optimal values of design parameters that permit maximum robustness.
- **Assemblage evaluation:** This method allows the evaluation of designs with respect to ease of assembly.
- **Design for manufacturability guidelines:** This method uses guidelines derived from years of design and manufacturing experience.

Ensuring that the functional and performance objectives are balanced within a cost limit imposes a tremendous challenge for design engineers. DFMA needs a blend of experience, use of various tools and an interdisciplinary work team. Japanese firms have been practising DFMA for the last twenty years. It is used in a variety of situations such as design evaluation, manufacturing option assessment, etc.

Design for recyclability: Design for recyclability (DFR) is becoming important because of the need for environmental protection and pollution control. The aim of DFR is to minimize non-recyclable components or toxic components which are detrimental to the environment and to ensure that recyclable and non-recyclable parts and components can be separated at the time of disposal after use. The concept of life cycle analysis in the initial stage of design help the designers to use more empirical data on

recyclability parameters. The design of recyclability includes the following:

- Use of materials with high recyclability and low environmental degradative potential;
- Use of environmentally friendly materials which are biodegradable;
- Ease of separating recyclable and non-recyclable materials during disposal;
- Incorporating the concept of "green design" to create long life products;
- Reduced use of toxic materials or materials with a long half life and toxics such as arsenic, cadmium, mercury, etc.

Automobile manufacturers have already started using this method so that recyclable and non-recyclable parts can be easily identified and separated. The use of non-recyclable parts are minimized.

Design for reusability: Design for reusability (DFU) is a coding and classification technique that is used to classify designs by material, shape and manufacturing process characteristics.[9] The objective of design for reusability is to fit new items or designs into an existing classification to take advantage of the similarities of the class. This helps in reducing design and manufacturing time by reusing existing designs to produce new parts. It has been reported that 80 per cent of the parts required for a new product can be created from existing designs.[13] Only a small percentage of parts needed for a new product must truly be designed as completely new. In design for reusability, designs or parts are coded for reusability using the type of material they are made from, the shape or geometry of the part, and the manufacturing process used to create them. Design for reusability has a number of benefits, namely:

- Reuse of existing designs will reduce the time to design new products;
- Reuse of available designs reduces the cost of designing;
- Duplication of parts can be eliminated, leading to work reduction.

Boeing Co. has implemented a programme for the increased use of the concept of design for reusability. An electronic data interchange system is being used to identify parts available on the shelf from the supplier, or easily available from the supplier. EDI, when combined with design for reusability, is emerging as a powerful technique for improving flexibility and reducing design time.

Design and manufacturing interface is becoming eliminated because of the possibility of direct transfer of designs from CAD to CNC, as well as the other techniques. Intelligent manufacturing systems envisage this. Japan has a comprehensive project for the realization of the concept of intelligent manufacturing systems.[15] This will be the basis for the factory of the future.

Software support of design

Software support for design is improving because of the emergence of new object oriented technology, as well as high resolution graphics. Object oriented programming languages provide a way of integrating data definitions and processing rules along with objects. Design can be facilitated by the use of an object oriented database. An object oriented database contains objects defined by an object

oriented data model that covers objects, attributes, constraints and relationships.[9] Object oriented technology permits the creation of new objects from existing objects.

Another enabling software support is visual programming software. Pictures are no longer worth only a thousand words: faster computers, high resolution graphics and a host of scientific visualization software increase their value immensely. While 90 per cent of the scientific visualizations are adequately managed in three dimensions, researchers and software developers have begun to rely on cognitive psychology methods to effectively display overlays that require more than three dimensions.[16] Visualization techniques are used along with three dimensional digital imaging.

Probably no other area has had as much impact from scientific visualization efforts over the past five years than molecular modelling. It has been used in such diverse areas as ceramics, superconductors, polymers and drugs. Powerful computers, high resolution graphics, high speed data networks, large databases, user friendly software, etc., have changed the landscape of design.

Testing design alternatives at the time of design itself has become a reality. Finite element analysis software, such as "PowerSolver", on powerful workstations test for fatigue failure and other structural modes of failure. Knowledge bases, along with structural analysis, gives rise to "intelligent design". Knowledge bases store a wide range of information, such as rules, guidelines, tables and equations normally used for designing new products. The software uses data, knowledge rules, and routines to facilitate the testing of alternative design configurations. Advances in software are making design more user friendly and knowledge based.

Examples from selected industries

A number of firms are implementing (a) newer technologies to realize new products; (b) new management techniques for design management; and (c) collaborative design. These leading edge companies set the rules and expectations of the market and they are perceived as progressive and innovative.[17] The shelf-life of many products has shrunk considerably over the past few years and as a result, the time to deliver products to the market has been reduced. The firms have to re-engineer their strategies for new product development so as to reach the market and also to sustain the speed of innovation.

Product data management systems help companies to streamline and fine tune their product development processes to shorten the time to market.[17] Product Data Management packages provide for better management of design and rapid access to product information. Product data management is one of the aspects of engineering data management. Engineering data management involves functions such as:

- Management of design user rights,
- Data conversion and communication, and
- Multiple access control.

Engineering data management systems help designers to manage, organize, access and control engineering data. Engineering data management referred to as product data management systems, or engineering information management systems, or product information management systems, provide improved management of engineering processes through a better control of engineering data, of engineering activities, of engineering changes and of product

configurations.[17] Using standardization capabilities of software, such as "Aspect Development" and design libraries, Kodak significantly reduced the cycle time of its newest single use camera.[17]

To meet the current competitive challenge designers are using a variety of engineering software that accurately predict product performance. The Boeing Co. recently produced the new B-777 aircraft. It has been the first large passenger aircraft to come out without a physical mock-up. It used "digital product definition" using computers.[18] The B-777 design and manufacturing involved the following aspects, namely:

- Extensive use of electronic data interchange,
- Networking with co-manufacturers,
- Well trained engineers,
- Finely tuned concurrent teams, and
- Cutting edge software.

The Boeing Co. has also used advanced visualization techniques, as well as virtual reality for visualizing the aircraft's interior and for improving its maintainability.[18] Boeing Co. has improved its design management systems and design productivity, as well as office productivity and manufacturing productivity. The company has also used the concept "Design to Build Teams" in which the "concept to manufacture cycle" is dealt by a single multidisciplinary team. The B-777 Programme consisted of 700 such design-to-build teams. The concurrent design was the result of multifunctional work and team integration.

The automobile sector has been one sector which has been sharpening its design capabilities. Chrysler has been one of the corporations which has applied advanced design techniques.[12] Chrysler was the first US automobile manufacturing firm to use concurrent engineering, rapid prototyping and a common platform for design and manufacturing. Chrysler uses "stereolithography" along with process driven design to improve quality. Stereolithography is used to create three dimensional plastic components directly from "CATIA" (CAD System). Chrysler designs 78 per cent of its models using three software packages, namely:

- CATIA
- Pro-Engineer
- AutoCAD

Using these, along with rapid prototyping machines, a variety of models have been made and used. The rapid prototyping, or electronic prototyping, is used for the following objectives at Chrysler:[12]

- Proof of packaging
- Design verification
- Component optimization
- Vehicle development testing.

Chrysler has used secondary tooling from master patterns made by rapid prototyping to provide a fast means of prototyping components using traditional mould making or foundry techniques.

As global competition increases, automation of design, rapid prototyping, as well as concurrent engineering, will be increasingly used (a) for shortening the product development cycle time; (b) for facilitating design team interaction; and (c) to smooth the design to manufacturing transition.

Design and competitiveness: implications for developing countries

The design stage has the maximum strategic leverage to influence the new product development success, as

shown in figure 5. The industrial competitiveness can be disaggregated to intrinsic competitiveness, which arises from the newness of the product or the novelty of the technology. After the design is frozen and investment has been made, intrinsic competitiveness cannot be influenced. After the manufacturing stage, only extrinsic competitiveness can influence the product's success. Extrinsic competitiveness relates to aspects which are extrinsic to the product. Because of global competition, intrinsic competitiveness is becoming crucial. Most of the developed countries have been weak as far as industrial design is concerned.

Information technology is helping firms to create and sustain competitiveness through a variety of new technologies. Some of the emerging options are given in figure 6. Collaborative design, teleconferencing of users and designers, large databases, large data transfer networks, visualization, multimedia, intelligent CAD, active offices, etc., are the facilitating elements which help in creating and sustaining industrial competitiveness. Whereas extrinsic competitiveness deals with aspects such as distribution, advertisement and after sales support. If the firms in developing countries have to create and sustain industrial competitiveness they have to implement a variety of initiatives to improve the intrinsic competitiveness, namely:

Train people in industrial design, especially in the use of new design software and newer design technologies;

Evolve a thrust programme for cooperative working between designers, research technologists and industrial manufacturers;

Industrial research establishments have to implement concurrent engineering approaches in order to realize new products;

Sensitize senior industrial executives about the new industrial design technology trends;

Institute industrial design awards and prizes;

Promote design consultancy in developing countries;

Develop design facilities which can help small and medium enterprises;

Implement design data networks and electronic data interchange.

Design will be the key capability that will distinguish winners and losers in industrial competition, and developing countries have to strengthen the institutional capability for new product realization through enhanced industrial design competence. Efforts have to be made to facilitate the use of design skills in small and medium enterprises. With the availability of engineering workstations and user friendly software, design has come within the reach of even small enterprises. Computer aided design, product data management systems, electronic data interchange, etc., will diffuse rapidly, even to small and medium enterprises, and only then will they be effectively integrated into the global economic web.

Figure 5. Strategic leverage and design

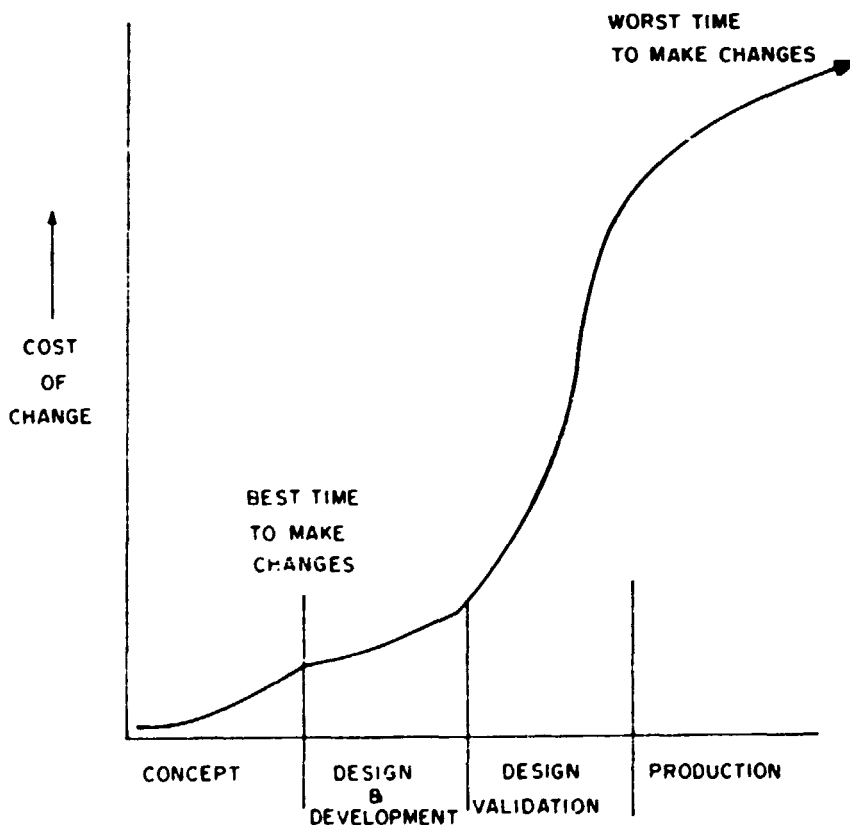
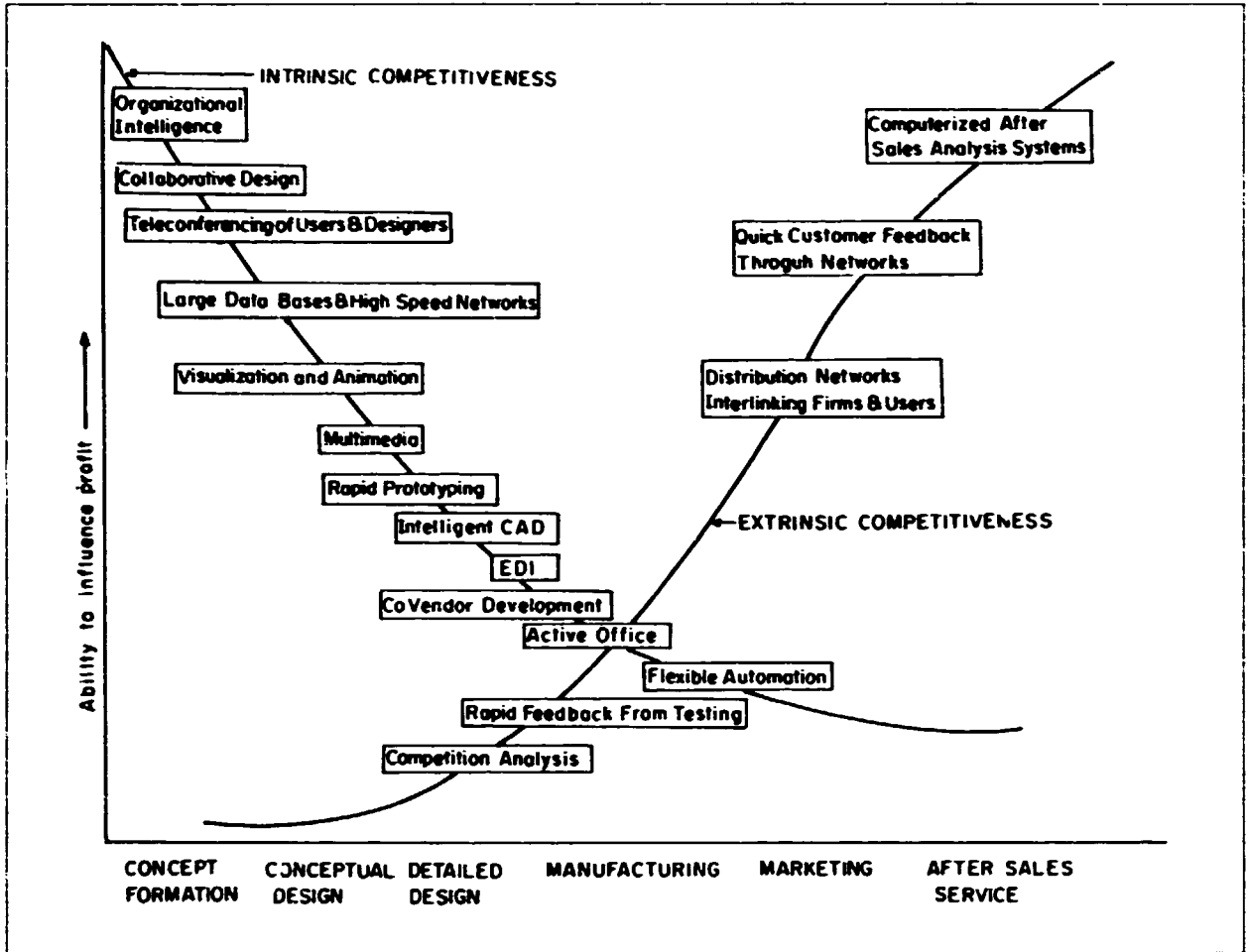


Figure 6. IT and competitiveness



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B. NEWS AND EVENTS

Maximizing the value of information

Despite all the technological advances that have occurred in the past few decades, white collar workers still spend a large amount of their time retrieving and manipulating information from various sources in order to perform their jobs. Some information resides on computers of different makes and types, some exists on paper and other traditional media, and some must be accessed through personal interactions. The overhead involved in managing and integrating these pieces of information is a major barrier to enhancing productivity.

No single organization, however, can today design solutions encompassing all these issues. Instead, industry, government, and academia must work in concert to develop approaches that can surmount strategic, organizational, and technical barriers to the effective deployment of information technology (IT). This concerted approach is emphasized by the PROFIT (Productivity from Information Technology) Initiative. PROFIT was established two years ago at MIT's Sloan School of Management to define new processes and technologies required to gain greater productivity from IT in both the private and public sectors.

PROFIT developed from a conversation Dr. A. Gupta, co-director of PROFIT, had a few years ago with MIT President Charles Vest about establishing a research programme at MIT that would relate to the IT industry in much the way the Leaders for Manufacturing (LFM) Programme relates to the manufacturing industry. Just as the LFM sponsoring organizations benefit from their association with the programme, PROFIT sponsors participate in seminars and symposia, serve as study and test sites for research activities, use knowledge gained from the programme, and have access to material developed by the research teams; this includes a software package for automated "reading" of handwritten material at high speed and accuracy.

According to Dr. A. Gupta four themes are driving PROFIT to maximize the value of data and make it the truly valuable corporate resource. These include: (1) automated data gathering; (2) efficient data integration and dissemination; (3) re-engineering of processes; and (4) better appreciation of the relationship between investments in information technology and overall productivity.

Apart from specific technologies PROFIT researchers have analysed the impact of information technology on productivity in different sectors of the economy; the overall numbers are far more impressive than previously thought.

For more information about PROFIT contact Julie Mallozzi, MIT Sloan School of Management, Room E53-310, 50 Memorial Drive, Cambridge, MA 02142-1347. Tel.: (617) 253-8584, Fax: (617) 258-7579, e-mail: profit@mit.edu. (Extracted from *The MIT Report*, December/January 1994-95)

Information route to success

Information work or, among its practitioners, information science is a growth area for jobs. At the specialist level it combines a requirement for detailed subject knowledge with an ability to seek out and identify sources of information, assess the validity of the information obtained, and piece together from a variety of disparate sources sophisticated industrial, business and economic intelligence. At its most demanding it can

provide companies with data critical to policy decisions. For this reason, far from being "only library work", it can offer access to top jobs in industry, business, and the public and private sectors. And--of good news to scientists--there is still a shortage of suitably trained and qualified practitioners in the scientific and technical field.

Information science in the mid-1990s increasingly revolves around the use of information technology, yet it is not a computer-science-based job. It concerns the principles and practice of the production, organization and provision of information. It includes the study of information from its generation to its exploitation, and its transmission in a variety of forms through a variety of channels. Inevitably, it seeks to exploit the potential of computer applications to their utmost.

As the information revolution gathers pace, society is suffering more than ever from information overload. Key requirements for any information scientist are: familiarity with the subject and its controversies and debates, familiarity with the various sources of relevant information, a nose for new and unorthodox sources, and an ability to read between the lines of the press and identify not only what has been said, but what has not been said and why.

In spite of the increasing availability of information on CD-ROM, on-line databases and academic bulletin boards accessible through the Internet and commercial networks, much information will be available more cheaply elsewhere, in printed rather than electronic form.

The information scientist, however, will definitely need electronically to access other information available over government networks or other databases. He/she will have to decide on the usefulness of the information generated--whether to download it on to internal databases, whether to use it to complement or supplement information already held--and to deal with issues such as classification, sorting and indexing of information held in electronic media.

The information scientist, then, is a mediator between his/her subject and the community of users, and a provider of services that access information in the most cost-effective way. In order to provide the right information, the information scientist must be able to communicate with clients and users to ensure that the information obtained is what is needed, available in a useful form and accessible where and when it is needed. As well as having subject knowledge and systems expertise, an information scientist needs strong inter-personal skills. Without talking to users, it will be impossible to keep abreast of an organization's changing needs and priorities.

On a day-to-day basis, information scientists will be required to undertake a wide variety of tasks. These include writing abstracts for company reports, systems analysis and design, the implementing of commercial intelligence systems to ensure the effective collection of information on competitor activity, and the evaluation of the scope and priorities of the service being provided. It may also be necessary to learn effective information presentation skills--desktop publishing and computer graphics. (Source: *Chemistry & Industry*, 16 January 1995)

The Internet takes off

Europe is now the region on the Internet showing the fastest growth. There are over one million hosts, with the UK the leader in terms of sheer numbers, followed by

Germany and France. Major growth is occurring in Spain, Portugal, Greece and the Czech Republic, although even the larger economies are showing Internet growth rates of 55-75 per cent.

The number of service providers is also increasing, making it easier for users to go on-line. The largest commercial service provider is EUnet, with more than 10,000 accounts in 40 countries. It focuses on small and medium-sized companies, although it does offer a low-cost service for individuals. EUnet is, however, now facing competition.

Pipex, a UK service provider, has formed Pipex International to attack the wider European market, and is forming strategic alliances with companies in various countries. It specializes in the corporate market, offering end-to-end managed services. IBM is offering the IBM Internet Connection Service for the equivalent of US\$ 20 a month, plus a setup charge of \$45. Apple will offer a means of accessing the Net via its Eworld service. Other players include IDT (International Discount Telecommunications), Deutsche Telekom, British Telecom, Europe Online and CompuServe. Pipex has demonstrated Internet access via a GSM mobile phone, and no doubt others will follow soon. Five GSM operators offer digital communications services.

An alternative to the Internet is presented by the French Minitel videotex system, but even in France, Internet access is growing in popularity. This year, the world will be able to access Minitel services over the Internet, whilst Minitel users in France will be able to use Internet Email and news services. (Source: *Byte*, February 1995)

A world without jobs

Since the beginning of the industrial revolution people have predicted that machines would destroy jobs.

Fear of what machines will do to men at work waxes and wanes. Right now, the fear is growing strongly. Are such fears justified? In one way, yes. Millions of jobs have indeed been destroyed by technology. A decade ago, the words you are now reading would have reached you from two sets of hands: those of a journalist and those of a typesetter. Thanks to computers, the typesetter no longer has a job. But, although the typesetter no longer has *that* job, he may well have a different one. John Kennedy put it well in the 1960s: "If men have the talent to invent new machines that put men out of work, they have the talent to put those men back to work". That is as true now as it was then, and earlier.

In the past 200 years millions of manual workers have been replaced by machines. Over the same period, the number of jobs has grown almost continuously, as have the real incomes of most people in the industrial world. Furthermore, this growth and enrichment have come about not in spite of technological change but because of it.

The idea that technology is capable of creating more jobs than it destroys, and will do so again, would not surprise an economist. Despite a huge investment in computing and so on over the past decade, unemployment in the USA, at around 5½ per cent, is currently no higher than it was in the early 1960s. In western Europe, where the investment has been smaller, 11 per cent of workers are jobless. This is hardly a persuasive sign that IT is a big cause of unemployment. Some of the new jobs in America have been disparaged as McJobs—hamburger flipping and the like. But such jobs do not seem to make up a big share of the total.

A new machine helps you make more stuff with fewer people. But the assumption that this results in fewer jobs rather than more output (and hence more goods and more job-stimulating demand, in a beautifully virtuous circle) is based on an economic fallacy known as the "lump of labour": the notion that there is only a fixed amount of output (and hence work) to go round. Technology creates new demand, either by increasing productivity and hence real incomes, or by creating new goods. New things go on getting invented. If output expands, productivity growth can march in step with rising employment.

Even if IT destroys more jobs than previous technical innovations, its pervasiveness also means that the compensating demand-generating effects will be stronger, with enormous investment and growth opportunities for the economy as a whole.

It is of course impossible to predict exactly where the new jobs will emerge over the next 25 years. Many jobs listed in the vacancy columns of today's newspapers did not exist in 1970. There are some clues, however, about where the expansion might come.

- In America in the past ten years, employment in the computer-software industry has almost trebled. The Bureau of Labor Statistics forecasts that between 1992 and 2005 the number of jobs for computer systems analysts and programmers will more than double—the fastest-growing occupations after home-health workers, who tend the sick in their own beds.
- The number of elderly people in the population is growing, and they are a lot richer than elderly people were 50 or 100 years ago. They will create jobs in—for instance—health care, home help, financial advice and the holiday industry.
- Rapid technological change increases the need for workers to train themselves for new sorts of work when the old sort gets done by machines. So there will be a growing demand for training, and teachers to do it.
- There is scope for a big expansion of the entertainment and information services. "Virtual reality" experiences, such as pretending to be a jet pilot for a couple of hours in a session with a sophisticated simulator, could become as popular as going to the cinema. If it does, it could create quite a lot of jobs.

The notion that technology creates more jobs than it destroys is borne out in a review of various economic studies published last year in the OECD's "Jobs Study".

If anything, says the OECD, the current wave of technological change has been modestly beneficial for jobs. The demand-boosting effects have more than offset the job-destroying ones. Indeed, the countries that have been most successful in creating jobs—America and Japan—have also seen the fastest shift in their industrial structure towards a high-tech, knowledge-based economy.

One difficulty with estimating the impact of technology on productivity and jobs is that it is hard to measure productivity in services. The huge investment which service industries had made in computing had made little measurable difference to productivity in the service sector.

The apparent failure of IT to boost productivity in services may in part be due to measurement problems.

• "The OECD Jobs Study—Evidence and Explanations". See also "The OECD Science and Technology Review", No. 15 (forthcoming)

According to the OECD, obsolete management structures inherited from the past have also hindered the efficient use of technology in many organizations.

Both theory and evidence suggest that in the long run new technology should create more jobs than it destroys. But the long run can take a long time. In the next decade or so, things depend on how quickly demand expands to match increases in productive capacity. Unfortunately, there may be prolonged lags between job losses and the creation of new jobs. And the new jobs may anyway be inappropriate for the displaced workers.

How can this problem of mismatch be alleviated? The familiar but none the less correct answer from the OECD is that compensating demand effects are likely to come through more quickly when general economic growth is strong, and when the markets for both labour and products are flexible. Governments can therefore help by making workers more adaptable through improvements in education and training, and by removing obstacles to free markets in labour and in goods and services.

Experience suggests that the worst thing governments can do about new technology is to try to slow down the period of adjustment by using subsidies, protectionist barriers or strict regulation. In many continental European countries many jobs were lost, but stricter regulations have hindered the creation of new products and jobs.

It is not always the least educated who are most at risk from new technology. But it is they who, if they do lose their jobs, may find it hardest to get new ones. (Extracted from *The Economist*, 11 February 1995)

Searching for cleaner electronic processes

A consortium of microelectronics makers and suppliers has been awarded a \$7.1-million contract by Wright Laboratories to develop new ways of making printed wiring boards. The work is funded by the US federal Advanced Research Projects Agency. The objective is to test alternative production methods that will reduce hazardous waste output and water and energy use. The consortium--the Microelectronics and Computer Technology Corp. (Austin, TX)--includes DuPont and several other microelectronics makers and suppliers. DuPont says the programme "is a direct result" of its effort to find more cost effective and environmentally benign technologies to make electronic components. (Source: *Chemicalweek*, 15 February, 1995)

Electricity cleans up contaminated land

The concept of cleaning up contaminated land without having to dig it up first is attracting mounting interest on both sides of the Atlantic.

Last year, US giants Monsanto, DuPont and GE Plastics joined forces to promote the use of electricity to "draw" wastes through "treatment zones" in the soil--the so-called "lasagna" process. Now EA Technology, the UK's former electricity research council laboratory, has announced a similar but apparently simplified electro-osmosis technique.

Born of an EA research programme sponsored by several of the recently privatized regional electricity supply companies, the technique involves inserting electrodes into the ground, with minimal land disturbance. The metal ions dissolved in the water are drawn towards the cathode and the acids towards the anode, where they can be dealt with subsequently. EA has patented an inexpensive electrode design, believed to be particularly effective for this type of remedial work.

Depending on the nature of the contamination, EA estimates the cleanup operation could taken between one and six months. The technique has already been tested on mercury-contaminated land at EA's headquarters site in Capenhurst, near Chester. A 5x5 array of electrodes was used to treat a 25m² area.

As the next stage in the development, EA is negotiating to work on other sites on a commercial basis. The company is hoping to work on one site in the UK and one outside Europe.

EA also believes the technique holds promise as a containment technique for landfill sites. One option available is to ring fence the landfill with electrodes and then prevent the contaminant from leaching into the surrounding groundwater, a spokesman explained. The company believes this may prove a particularly attractive option for large landfills where the source of pollutant may not be known. The cost of running the system would be relatively small.

Recognizing that while it has the technology, it lacks the infrastructure, EA is now seeking partners already active in the business of land decontamination with which to commercialize the process.

EA estimates that there are 90,000 priority contaminated sites in Europe and the US, which it believes will generate more than £2 bn (\$3.1 bn) of reclamation work. (Source: *European Chemical News*, 20-26 February 1995)

NEC develops recycling technique

NEC has developed a technique for recycling waste material from printed circuit board production. Up to 94 per cent of copper-rich metals are removed. The residue, mainly glass and solid epoxy resin, can be used as a filler for plastic mouldings. Plastics made with this filler can be twice as strong as those filled with traditional materials like talc or calcium carbonate. (Source: *Electronics Weekly*, 5 April 1995)

Competitive intelligence and social advantage

The concept of competitive intelligence (CI) goes beyond the traditional focus on business competition. There are emergent tools and techniques such as groupware and networking which allow the concept to be operationalized in terms of social advantage. There are covert and overt competitive intelligence considerations which cover a wide range of data diversity. Demotic data is important as is the information available via the Internet. New forms of organization are emerging which add a new dimension to corporate intelligence work. Sources that have not been analysed will not provide high grade competitive intelligence, which is the product of the value added process. Library and information science programmes can provide key CI skills such as searching, analysing, synthesizing, and interpretation.

It is concluded that as competitive intelligence draws on different subject areas and specialist skills, it should fit best with academic disciplines that span boundaries naturally such as communication or information studies. A school with an interest in CI might include systems experts, semioticians, marketing specialists, cognitive scientists, and reference experts. The skills developed may well lie outside the traditional framework of the business or corporate library. A new kind of gamesmanship may be demanded by the electronic playing field by free agents or contract workers with little or no emotional equity in buildings, collections, or formal professional structures. These people will need to be adept in navigating the Internet and skilled

in electronic eavesdropping. (Source: *Library Trends*, 43(2), 1994)

Information technology-enabled change: the risks and rewards of business process redesign and automation

The traditional approach to employing information technology (IT) within the organization was to automate existing processes within a given function, such as finance or marketing. In recent years, however, the competitive business climate has forced many companies to undertake thorough-going redesigns of their operational procedures, implementing systems which cross functional boundaries. This is usually referred to as business process redesign (BPR).

A number of risks associated with process change may be identified. Firstly, the irreversibility of the change process increases the costs or financial risks associated with project failure. Secondly, resistance to change increases the risk of failure. Thirdly, the change may introduce ambiguity or uncertainty into the work of the individuals concerned, inducing sub-optimal performance. Other risks arise out of crossing functional boundaries. They include those associated with structural change, increased structural complexity and parochial ownership of the process.

A postal survey of 300 information services directors produced 59 replies (20 per cent). Data derived from the study was used to model the respective risks and rewards associated with cross-functional and intrafunctional process change. A higher degree of satisfaction with the outcomes of the former was recorded, but organizations contemplating process redesign need to make provisions for the associated risks. (Source: *Journal of Information Technology*, 9(4) December 1994)

Strategic users of information technology: a longitudinal analysis of organization strategy and performance

While discussed extensively, very few studies have attempted to formally integrate the notions of organizational strategy, competitive advantage, and the strategic use of information technology. Utilizing the typology of Miles and Snow, this study attempts to identify the strategic orientation (prospector, analyser, defender) of widely cited users of "strategic information technology" before and after the launch of their innovative systems. Also, measures of financial performance are compared between emergent groups in order to determine if any particular strategic orientation consistently outperforms the others.

In general, this study reports four findings. First, it appears that strategic users of information technology are not concentrated along a single strategic dimension. The firms examined in this study exhibited characteristics associated with each of Miles and Snow's strategy types. Second, it seems that many firms shifted strategic orientation after the launch of their systems. Interestingly, these shifts were rather dramatic and seem to represent a fundamental change in strategic direction from earlier "presystem" operating philosophies. Third, case descriptions along with narratives of annual reports suggest that usage or competitive intent of these strategic systems matches the prevailing strategic profile of the initiating firms. In other words, the systems seem to support organizational strategy.

Finally, it seems that prospectors and defenders realized significantly higher measures of financial performance immediately after the implementation of "strategic informa-

tion technology"; however, in the long term no strategic orientation seemed to outperform the others. (Source: *Journal of Strategic Information Systems*, 3(4) December 1994).

Riding the information hypeway

Information is suddenly a fashion business. The mainstream press has built up the expectations of people regarding information delivery. They are heralding the arrival of the information highway. However, the definition of this so-called information highway (or information superhighway or infobahn, depending upon which publication you read), is so fuzzy, so inexact and so exaggerated that it might more justifiably be deemed the information hypeway.

The information superhighway is full of answers for questions. The problem is matching the question asked with the answer in the machine. Journalists tend to become enchanted with the number of answers in the networked machines. They forget to ask real questions that require real answers—the kinds of questions asked of information professionals around the globe every day. Having hundreds of thousands of answers is wonderful, of course, but quantity and quality are not the same thing. A journalist impressed with quantity of information confuses trivia with facts.

There are 7.9 million subscribers to online services and at least three or four times that number of people who use the Internet. There are 91.3 million personal computer owners. Television set owners number in the billions. No wonder the information industry is hoping for digital convergence. If we can count television owners as online subscribers, we truly have an industry. It may be hype but the information highway has done something that the more traditional services have not done. It has captured public attention. (Source: *Information World Review*, December 1994)

Business on the Internet

The NET has become one of the business buzzwords of 1994, with over 4,000 items appearing in Textline containing the word Internet in 1994—a 500 per cent increase over 1993. In addition, there is a sharper focus on business aspects of the Internet. Commercial information providers are generally the best source for company and market information. Some services, such as Dialog and Data-Star, are accessible via the Internet as an alternative communications route, but this is usually slower and what is saved on telecommunications cost may be lost in increased connect time charges. Other existing services such as Dow Jones are developing service options which make use of World Wide Web features. There are also completely new commercial services starting up on the Net, such as QuoteCom and UnCover. Useful free business information on the Internet is usually provided by an individual company about itself; provided by a firm that makes money out of other organizations by mounting data or selling services; or provided as a public service.

The US Government's information policy has resulted in a large volume of data being made available free. Some of the frenets operated by local or state authorities in the USA provide good data on the local community, and there are many sites, usually university-based, which focus on a particular topic. The UK Government has a small presence via the Treasury pages and a CCTA site. There are also discussion lists and USENET groups, examples being BUSLIB-L (business librarians) and E-EUROPE (for eastern and central Europe). Examples of new Net-based

products are given under the headings: sites providing information about an individual company and its products; commercial organizations taking on a public-service role; sites which enable product ordering; new products; sites acting as directories and shopping malls; new products; information products; and use of discussion lists and e-mail as an advertising medium. (Source: *Information Management Report*, January 1995)

The e-mail of the species

Electronic mail (e-mail) is analogous to its Royal Mail counterpart. Messages are sent from computers to other computers via telephone lines solely on the basis of an e-mail address. The post-box, sorting offices, transport and postmen are replaced in the electronic counterpart by computers (nodes) linked together by telephone lines. These nodes redirect messages to other nodes holding the addressee's address. When addressees dial into their local node (log on), their messages are automatically downloaded to computers at work or in the home, and can be read at leisure.

There are some catches. The first is that the Internet was an experimental creation and for some still is. The protocols lack the sophistication of, say, wordprocessing programmes. There are also substantial delays in logging on to the local node. If the node is down for any reason there is nothing to do but to wait until it is back on line, although most systems have an autodial facility.

The Internet is also frontier country, with minimal law enforcement and plenty of electronic hoodlums, some of whom see their mission in looking over and may be disabling your computers. Consequently, companies may confine their e-mail within their firms, and the best advice seems to be that external e-mail should be handled on a stand-alone machine and certainly not by any machine or network carrying sensitive information. (Source: *Learned Publishing*, 8(1) January 1995)

Some thoughts and predictions (on the Internet Age)

We have recently begun the third stage of the electronic information revolution—what we will probably come to call the Internet Age. The location of information will become less and less relevant as we can move information around more and more readily. The nature of the relationship between the players in the information arena will be up for grabs in an increasingly complex environment. The Internet will continue its exponential growth, at least through the end of this century.

The use of public key encryption will become routine. Probably by the end of this century, when we e-mail a message to a colleague then encryption via your colleague's public key, which will be kept both by your interface package and in a directory system available to all Internet users, will be the automatic default option, and if we want to send a message in the clear we will have to specify so. Commercial transactions will behave similarly. Indeed it is the need for secure and reliable commercial traffic that will drive this development.

Another prediction is that the ability to cram more and more data down an ordinary telephone wire will continue its exponential growth, and that by 2001 the connections to the house that already exists will carry at least two simultaneous full video channels and two voice conversations. This, coupled with the development of high throughput servers, will render the cable companies and our present

discussion of 500 channels an interim technology. (Source: *Online and CDRM Review*, 18(6) December 1994)

Electronics industry get serious about the environment

While the electronics industry in the United States may appear to be in the forefront of protecting the environment, the issue is now a global one.

In May 1994 for example, a conference titled, "The World's Environment—Where the Electronics Industry Wants to be in the Year 2000", was held in Brussels. This summit marked the first time that experts in worker safety, health and the environment joined to assess the impact of semiconductor manufacturing on a global basis.

The event was hosted by the European Electronic Component Manufacturers Association and co-sponsored by the Electronic Industries Association of Japan, the Korea Semiconductor Industry Association and the Semiconductor Industry Association.

Meanwhile, SEMATECH funded four new university-based environment, safety and health (ES&H) research projects. The Semiconductor Research Corp. (SRC) will manage the projects. These tasks are additions to the 28 with identified ES&H objectives which SRC has funded and manages at 15 universities. Two of the new projects focus on water use in chip making, the third relates to chemical use and the fourth will study lithography.

At the University of Arizona, researchers will develop tools and techniques to overcome technical obstacles related to ultrapure water recycling in semiconductor manufacture. Stanford, meanwhile, will provide critical models, methodologies and sensors to optimize surface preparation and DI water rinses. The goal is to achieve lower water use and reduced costs in chip making, as well as better performance.

North Carolina State University will determine methods to sense emissions which might be environmentally harmful and optimize processes and equipment to cut emissions.

Finally, the University of Texas will work on developing new resist materials designed to minimize the environmental impact of the lithography process. The research will include an exploration of new imaging chemistry that could provide a means for water-borne coating and development. (Reprinted with permission from *Semiconductor International Magazine*, December 1994. Copyright 1994 by Cahners Publishing Co., Des Plaines, IL, USA)

Will eastern Europe be the world's next chip assembly capital?

Asia has been the capital for package assembly for at least two decades. From time to time, other regions, Bangladesh and Casablanca in Morocco, for example, bid for some of the package foundry business. Joining that short list soon will be such countries as Belarus.

With the fall of the Iron Curtain, do not be surprised to see Eastern Bloc republics entering the package foundry business, to supply mostly US and western European companies.

One of the first countries to vie for western business is Belarus (formerly Byelorussia). Through a US contract for more than \$8 million, the Kras Corp., Fairless Hills, Pennsylvania, has been selected to upgrade Integral Semiconductor, Belarus' largest device maker. Through contracts like this one, the US plans to help domestic companies upgrade former USSR defence firms into non-military enterprises. Kras will work with Amkor

Electronics to upgrade Integral with state-of-the-art assembly equipment.

A separate manufacturing module, known as Intekras, will be set up to handle foreign contract assembly work for Amkor.

Packages assembled in Belarus will meet quality specifications virtually identical to established plants in Asia.

Integral in Minsk, the capital of Belarus, is the largest semiconductor maker in the former Soviet Union. At one time, Integral employed 40,000 workers in six Belarus factories—about 10 per cent of the city's population. Integral also has several fabs, but front-end processing is not included in the Kras contract. (Reprinted with permission from *Semiconductor International Magazine*, November 1994. Copyright 1994 by Cahners Publishing Co., Des Plaines, IL, USA)

Digital rights: ideas of openness and free exchange of information are clashing with the right to control creative material on the Internet

As the concepts of freedom of speech and of the press gained currency, so did copyright law emerge as a means of protecting the rights of those creating original material. Increased media and public interest in the Internet is now raising issues of how those rights and freedoms may conflict.

By its very nature, the Internet developed in largely anarchic fashion, with no central direction or control. Many users have relished the freedom with which scanned-in text and images may be exchanged over the Net, and would fiercely resent any attempt to curtail such activities. The growing interest of commercial concerns in the Net, however, means that copyright laws will be enforced more strongly and coherently than has previously been the case.

Certain myths regarding copyright are common. There is the idea that infringement only occurs if a charge is made for the pirated work whereas in truth, the distribution alone constitutes infringement. Another notion is that copying a single article or image—as opposed to a whole book—does not break the law. US law is, however, quite specific: once an original work is created, the author enjoys full rights in that item, including those of reproduction and distribution. *Playboy*, for example, successfully obtained an injunction preventing images being scanned and uploaded to a Florida BBS.

An individual author may not place a copyright notice on a work to enjoy protection, but it is helpful if a case must be pursued in law. The work can also be registered with the US Copyright Office. (Source: *Internet World*, November/December 1994)

The trouble with IT

A recent seminar focused on the disillusionment with IT experienced by many users. For many companies, IT has at best automated yesterday's manual systems, at worst left them with ill-assorted systems apparently incapable of supplying the information needed by the business. Many are now reducing IT budgets and subcontracting their computer operations to third parties.

The recession has caused IT budgets to be put under much closer scrutiny than has previously been the case. In the past, the mystery surrounding IT meant that it escaped cutbacks when times were hard, but this is no longer the case. US surveys have suggested that companies have gained at most a 1 per cent improvement in productivity

through the introduction of IT, causing senior management to become sceptical as regards its alleged benefits.

In part, the emphasis on hard- and software, rather than on solutions to business problems, has played a part in excluding senior managers from the procurement process and therefore specifying what is required in terms of results rather than performance measured in millions of instructions per second.

Abandonment of IT by outsourcing, however, can mean that companies are disregarding a key competitive weapon. The combination of technology and creative business thinking can be a powerful one: First Direct in banking, and Direct Line in insurance, provide examples. Some company boards, however, persist in regarding IT as an overhead rather than as a valuable resource. Moreover, even when they acknowledge that IT must be employed, they tend to concentrate on tactical issues, or what the competition is doing, rather than on the long-term potential of IT to re-make the business. (Source: *Management Today*, November 1994)

Virtual organization: a vision of management in the information age

Virtual organization is an assessment of a new paradigm of organization and management. Like most new ideas, virtual organization is not entirely new—some of its components are recognizable from earlier concepts of organization. However, the integration of all the components does signal something new and revolutionary. Its revolutionary character stems from the principle of switching (i.e. shifting between means for satisfying a need), which calls upon management to maintain a logical separation between abstract requirements and the concrete means for their satisfaction. Advanced information technology makes it possible to realize virtual organization in practice, and the paradigm is clearly manifest in the operations of some innovative firms.

The economic and social significance of virtual organization in the future is likely to be comparable to that of the factory in an earlier period. Properly implemented, virtual organization may deliver increases in efficiency and effectiveness on an unprecedented scale. At the same time, it may stimulate social changes at least as far-reaching as those associated with the industrial revolution. This article provides a precise definition of virtual organization and undertakes to justify these claims about the new paradigm. (Source: *The Information Society*, Vol. 10, October/December 1994)

Women and information technology opportunities and challenges—a social issue

Information technology is driving us towards a digital world. What we see now is the beginning of a long road which changes many if not all aspects of our lives, including our workplace, leisure, creativity, and family life. This provides important challenges for society to cope with and creates new opportunities for women to strengthen their role in society. The following quotation from I&T Magazine shows us the digital world as it will be, perhaps in the first decade of the twenty-first century:

‘Homes and offices are now connected at minimal cost to thousands of powerful and easy-to-use digital services. The precursor of them all was the French Minitel at the end of the twentieth century. These services cover about all of human activities ranging from working at home independently or for a

company—to the distribution of music, movies, custom-made news or cooking recipes directly displayed in the kitchen.

"The quantity and the richness of the resources made available to almost everybody has given rise to new sources of revenue rewarding the creative intellectual production of all individuals. For example, an attractive or interesting photograph (digital of course) can be loaded from your home in specialized databases served by information agencies. Having specified from your terminal the owner of the information as well as the fees attached to future use of your creation, you will be automatically paid should anyone find your creation useful for his personal or professional use. The information will be automatically deleted from the database or returned to you if after a certain period of time it has not been accessed by potential users. Indeed, a new profession has been created just for tracking information potentially interesting for certain organizations, for example news agencies.

"On the other hand, you can pay for any information or services you use with a personalized 'smart' copyright/payment card. This card is used as an electronic debit card for general-purpose payments but also has particular features specific to certain applications. For copyright operations payments are made instantly on-line when you are connected to a server. For off-line operations, payments are debited from a prepaid amount loaded in your card and the information to whom the payment has to be relayed—(copyright owners and service providers)—is transmitted each time you re-load your card to renew the prepaid amount stored in it or whenever you make an on-line transaction.

"One of the most popular services is to get well-known paintings of famous artists displayed on large extra-flat LCD screens, with colorimetric correction features, hung on your walls; usage fees could be for just one evening or for a whole year, and the image disappears automatically at the end of the rental period."

However, looking at the closer future between the present and the end of this century, some applications could change the office environment, also within the UN system, fundamentally from the one we are accustomed to.

Let us consider, for example, the already existing "talking dictation computer" which, although its use is not yet widespread, can produce an electronic or, if needed, printed copy of a dictation. How many relatively low-skilled jobs will be eliminated by this device? This could certainly be considered as an example of a labour-endangering phenomenon such as those which have accompanied the development of information technology almost from their advent. It may, however, be regarded differently—as an example of the new information environment in which change is the essence of reality. This brings a new element to our lives; one which has been absent in

all past generations of humankind, and one which is, to some extent, psychologically difficult for the individual to cope with.

This problem results from the fact that human beings are most apt to learn in their youth. In the past, skills acquired in one's youth sufficed to cope with the technological environment throughout one's whole life. Now change is very fast, and those born more than half a century ago now live in a world not only technically but also socially essentially different from the one they grew up in. In many cases this has resulted in difficult adaptation to the new working and social environment, sometimes leading even to alienation. One should realize, however, that from our generation on this will continue, and we, as well as the next generation, must learn to live in such a dynamically changing world.

For women, however, the situation is easier than for men. Anthropologists tell us that women as a gender are better adapted than men for coping with complicated social environments. Therefore, their chances of adapting to the changes brought on our lives by advances in information technology are more favourable.

To contend with these circumstances, however, an awareness must be created that these constant changes are inevitable. The first conclusion is obvious. The rapidly changing work environment and social world generally require a life-long learning process for everyone.

Information technology not only invokes the pressure for permanent learning, but also provides the means to implement it. The use of satellite as well as terrestrial communication lines for distance learning, and broadband telematics for interactive video, video conferencing for professional training, and INTERNET as a global system for virtual university, are just some of the means offered.

The vital task for organizations and institutions, in our case the UN system, is to make these new educational means easily available as soon as possible. In our competitive world those who appropriate these means early will have a tremendous advantage over the latecomer. Thus, the recommendation to bring the availability of information technology to women, independent of their current professional position within the UN system, provides them with opportunities not only to keep up with the development of information technology needed in their present work, but also opens avenues to develop new skills in areas which are now emerging (e.g., the virtual library) and will continue to materialize in future.

Therefore, new information technology should not be regarded as a threat to the established labour modes, but rather as an opportunity for women to jump into an emerging labour niche, providing a chance to master skills now in short supply on the labour market, and thus ensconce themselves as highly qualified and singular specialists. (Taken from a paper prepared by Konrad Fialkowski for a seminar on Women and the United Nations—Reflections and New Horizons, held at Vienna, Austria, on 4-5 May 1995)

C. NEW DEVELOPMENTS

Biocomputing could fast outdo the chip

A promising new avenue is opening in computer science. Spurred by a paper published a few months ago describing the solution of a difficult mathematical problem using the chemical units of DNA as computing symbols, researchers are planning systems that would use the genetic material for computations that would in some cases thwart even the fastest supercomputers.

One new proposal is for a memory bank containing more than a pound of DNA molecules suspended in about 1,000 quarts of fluid, in a tank about a yard square. Such a bank would be more capacious than all the memories of all the computers ever made. The reason is that chemical reactions occur very fast and in parallel, so that if the DNA molecules are synthesized with a chemical structure that represents numerical information, a vast amount of number-crunching is done as the reaction proceeds.

Another project is a computation that would involve manipulating DNA molecules. It would take four months to complete and would yield, at its end, the answer to a problem that, with a conventional computer, would require more operations than all those ever performed on all the computers ever built.

Computer scientists have sketched out ways in which DNA computing systems might in principle break the Government's data encryption standard system and attack the notorious challenge known as the satisfiability problem.

Researchers explain that they now realize that in DNA nature has created an extraordinary, special purpose computing system. DNA and the genetic machinery that processes it store and retrieve a prodigious amount of information—all that is needed to design and maintain every kind of living organism. Scientists think they can make DNA work for them by using the same genetic machinery that generates living organisms to solve mathematical problems.

The nascent field of DNA computing got started only five months ago with an article in *Science* by a leading computer theorist, Dr. Leonard Adleman of the University of Southern California in Los Angeles. Dr. Adleman explained how a problem could be set up by synthesizing DNA molecules with a particular sequence, and solved by letting the DNA molecules react in a test tube, producing a molecule whose sequence is the answer. In his paper he recounted how he had put his theory into practice by solving a standard problem with a DNA reaction system.

Dr. Adleman dubbed his DNA computer the TT-100, for test tube filled with 100 microlitres, or about one-fiftieth of a teaspoon of fluid, which is all it took for the reactions to occur.

Conventional computers represent information in terms of zeros and ones, physically expressed in terms of the flow of electrons through logical circuits. Builders of DNA computers represent information in terms of the chemical units of DNA. Calculating with an ordinary computer is done with a program that instructs electrons to travel on particular paths; with a DNA computer, calculation requires synthesizing particular sequences of DNA and letting them react in a test tube. In a scheme devised by Dr. Lipton of Princeton University, the logical command "and" is performed by separating DNA strands according to their

sequences, and the command "or" is done by pouring together DNA solutions containing specific sequences.

The advantages of DNA computers would be that they are a billion times as energy efficient as conventional computers. And they use just a trillionth of the space to store information.

But, most important, computer scientists describe DNA computers as "massively parallel", meaning that with billions or trillions of DNA molecules undergoing the chemical reactions it would be possible to do more operations at once than all the computers in the world working together could ever accomplish. For example, a DNA computer could easily have 10^{20} DNA molecules (that number is 1 followed by 20 zeros) in a tiny test tube doing calculations simultaneously. A conventional computer would have no more than a few hundred to perhaps a thousand independent processors.

No one expects DNA computers to replace laptops or other computers based on silicon. Instead, researchers said, the two types of computers could complement each other, perhaps in the form of hybrid machines. Some memory, for example, might be stored in DNA, or certain huge calculations might be done in the laboratory with DNA and the results fed into a conventional computer for further analysis.

One of the simplest ways to use DNA might be as a memory system. The information could be encoded into DNA sequences and the DNA could be stored. To retrieve data, it would only be necessary to search for a small part of it—a key word for example—by adding a DNA strand designed so that its sequence sticks to the key word wherever it appears on the DNA.

A DNA memory could hold more words than all the computer memories ever made. For example, with DNA, some 10^{14} words could fit easily in a test tube.

Searching a DNA computer memory would be slow, however, taking about 17 minutes to nearly three hours to find a sequence, so it would be most useful when speed is not of the essence.

Still, DNA computers might solve certain kinds of problems faster than the fastest supercomputer. One is the satisfiability problem, a notoriously difficult computer science problem that involves lengthy logical equations. A DNA computer should be able to solve a satisfiability problem with 70 variables and 1,000 and-or connections.

A possible approach to such a problem would be to assign various DNA sequences to represent zeros and ones at the various positions of a 70-digit binary number. Vast numbers of these sequences would be mixed together, generating longer molecules corresponding to every possible 70-digit sequence. (Larger and smaller numbers would also be generated but they would be screened out.)

This solution of 70-digit numbers would then be mixed and separated in a series of operations corresponding to the "and" and "or" commands of a computer program. For example, the logical statement "X or Y" is true if X is true or if Y is true. To simulate that, the scientists would pour the DNA strands corresponding to "X" together with those corresponding to "Y". In the end, the DNA molecules that emerge from this process, if any, would represent the solutions to the problem.

DNA Computers: Pro and Con	
Although biological computing is still in its infancy, scientists are already speculating about its practical advantages and disadvantages.	
DNA Based Computer	Chip-based Computer
Could do individual operations very slowly	Does individual operations very fast
Could do billions of operations at once	Can do significantly fewer operations at once
Vast potential memory in a small space	Has a significantly smaller memory
Setting up a problem would be difficult, requiring synthesis of specific molecules	Setting up a problem merely requires punching in the numbers to be calculated
Requires less energy	Has significant energy requirements
DNA is subject to physical damage and deterioration	Electronic data are vulnerable but backup copies can be made
<i>The New York Times</i>	

(Extracted from *Deccan Herald*, 15 May 1995)

Breakthrough in superconducting

US Government researchers claim to have created a breakthrough superconducting material that is flexible rather than brittle and can be used in a wide number of applications.

Scientists at the Los Alamos National Laboratory in New Mexico described the new material at a meeting of the Materials Research Society.

They demonstrated a flexible metal and ceramic foil that they said can be made into wires with a huge current carrying capacity at liquid nitrogen temperatures.

The superconductor is a ceramic material based on yttrium barium copper oxide deposited on a nickel tape to give it flexibility. Previous superconducting materials have been too brittle to form wires.

The superconducting material is said to carry more than 1 million amperes per sq cm compared with No. 12 copper wire that carries 800 A per sq cm. (Source: *Electronics Weekly*, 26 April 1995)

Journey to the centre of the chip

Chip designers in the near future may "fly" around their complex creations with virtual reality systems, according to a top chip design expert at California's prestigious Stanford University.

According to Robert Dutton, professor of electrical engineering and chief scientist at Stanford's Center for Integrated Systems (CIS), virtual reality systems for chip designers might soon become the norm in order to deal with the complexities of designing ever smaller circuits. The smaller chip feature sizes will require 3-D modelling systems which can be easily adapted to become virtual reality systems where designers don special goggles and slip on data gloves to navigate through submicron geometries.

Dutton believes that the development of 3-D modelling systems will be essential to future chip design simply because of the laws of physics. As chip element sizes head towards the 0.1 μm and sub-0.1 μm scales, electron interactions begin to change, requiring chip modelling systems to take into account effects between electrons and the edge of transistor devices.

This will require 3-D simulation and the solving of large numbers of simultaneous partial differential equations—well beyond the scope of today's chip modelling systems running on high end workstations.

One answer to this formidable computational problem is to use computers with several, or even hundreds of, microprocessors operating in parallel, with each processor tackling part of the equation solving. While parallel processing computers are capable of incredible processing performance, they can only achieve their potential provided that special software can be written that can break up a problem into tasks that can be run simultaneously.

This is where the Stanford researchers believe that they have achieved a breakthrough towards the eventual goal of 3-D chip modelling. Using 2-D chip modelling tools already offers chip companies considerable cost savings in the millions of dollars range and cuts down on chip design time to bring additional competitive advantages. Using 3-D modelling techniques offers the potential for even greater savings.

An IBM SP-2 system "brings three-dimensional simulation capability down to a price that semiconductor companies can afford. It also runs fast enough so that designers can really use it. At these rates, 3-D will take about the same time to run as current two-dimensional simulations", Dutton said.

There is also the potential to port the Stanford developed algorithm to smaller and cheaper parallel processing workstations that while solving only several thousand equations simultaneously, would still offer compelling cost and time savings. The algorithm can also be adapted to speeding up 2-D chip modelling systems.

The algorithm has already been incorporated into a new version of the PISCES chip modelling program which models the behaviour of electronic devices in complex microprocessors. IBM is very interested in the technology and is working with Stanford researchers to incorporate the algorithm into its 3-D FIEL-DAY chip simulation software.

"There are some new technologies, like sub-tenth-micron CMOS, silicon-on-insulator and silicon-germanium technology, where we do not really capture all the behaviour correctly in 2-D, so we really need 3-D modelling", said Ronald Knepper, an IBM researcher working with Stanford's CIS.

Dutton also sees 3-D modelling becoming an essential component in the design of optoelectronic devices, and microscopic machines such as accelerometers used in automobile air bags. (Source: *Electronics Weekly*, 12 April 1995)

Plastic transistor technology

With the latest advantages in plastic transistor technology it will soon be a simple matter of rolling up your laptop computer and placing it in your pocket.

Up to now throughout the electronics industry, all semiconductor devices have been fabricated from silicon or gallium-arsenide, but scientists at the Laboratory for Molecular Materials, a division of CNRS in Thiais in

France, lead by Francis Garnier, have shown that organic polymer materials can be used to produce just as good electronic devices as silicon. The all-polymer devices show good electrical characteristics, are fully flexible and above all they are considerably cheaper to manufacture than silicon.

The first work on this subject started five years ago under the umbrella of the Ministry of Research in France which partly sponsored it. CNRS Thomson Electronics and Philips were all involved in this project. Now interest in these devices is rising and many large electronics firms are already researching the possibilities of using them in many applications which will replace silicon-based transistors.

The structure for silicon and gallium-arsenide is crystalline, whilst organic materials contain carbon molecules which are fairly large. This molecular size affects the size of the electronic device. But it is this molecular structure and the weak Van der Waals interactions, with low cohesion characteristics, which allow the easy processing of organic materials.

The main advantages of polymer transistors are their flexibility and ability to bend, twist or even be rolled without their electrical properties being affected. They also have very good optical properties, and can be easily processed, even on large surfaces.

Researchers developed the first polymer substrate semiconductor device, initially with metal electrodes. These devices showed better carrier velocities and good electrical characteristics, but were unstable with the metal contacts breaking off due to mechanical incompatibility with the flexible substrates.

Continuation of the research into these devices led to two major breakthroughs. One was related to the molecular structure of the polymer material. The other was related to the work of Dr. Richard Friend at the University of Cambridge, who showed that an organic semiconductor could be efficiently used as an active layer in electroluminescent diodes.

The all-polymer device is still relatively large, but by using convectional printing techniques the channel lengths can be reduced to 50 μm and channel widths from between 0.5 mm and 1 mm. These dimensions still compare unfavourably with a silicon transistor's channel lengths, which range between 2 and 5 μm .

But even with these dimensions the new polymer devices can find use, especially in macrosized applications such as displays, electrode arrays, photovoltaic cells, smart cards and control electronics for plastic LEDs.

The first low-grade applications are expected as soon as 1996 and 1997.

But one very interesting aspect of these devices is in the way they can be produced in volume. Researchers have shown that web printing techniques similar to those used in publishing will be a good method of manufacturing them.

This will reduce the cost related to volume fabrication drastically, opening the way for large-area, low-cost plastic electronics. (Extracted from *Electronics Weekly*, 29 March 1995)

X-ray chips

In February 1995, the world's first working samples of 1 Gbit DRAMs were unveiled at the ISSCC chip conference in San Francisco.

The devices shown by NEC and Hitachi were laboriously hand-crafted. 1 Gbit DRAMs will not be in com-

mercial production until after the year 2000. Yet, less than a week after the ISSCC presentations, a production facility capable of drawing lines on a wafer thin enough to make a 16 Gbit DRAM was formally opened.

Based at Sandia National Laboratories in Livermore, California, the facility uses soft X-rays to draw lines spaced just 0.1 μm apart on a silicon wafer.

The production line is the result of a five-year collaboration between Sandia and the lithography research department at AT&T's Bell Laboratories. It is the first complete lithography system in the world capable of producing 0.1 μm features on a wafer.

The team which developed the system believes that it could form the basis of a commercial production line that would be simpler, cheaper and more compact than any other proposed 0.1 μm production technology, such as synchrotron hard X-ray lithography or systems based on beams of electrons or ions. They are also confident that the technology can be extended well beyond the 0.1 μm generation.

The Sandia/AT&T system includes virtually all the elements needed for a commercial production line, including a laser source, reflecting masks, X-ray imaging optics to focus the mask pattern on a wafer, X-ray photoresists and a sophisticated alignment system using magnetic levitation to reposition the wafer accurately between lithography steps. (Extracted from *Electronics Weekly*, 8 March 1995)

Big power in little package

Ultralife Technology has announced what it claimed to be the world's first commercially available rechargeable lithium-ion solid polymer battery, which has the potential to be small and flexible enough to fit into a ski glove.

It consists of several layers, the core of which is a polymer membrane that represents the solid state electrolyte. It has a carbonaceous anode and a lithiated metal oxide cathode. The whole structure is housed in thin plastic foil. The battery's size, weight, efficiency and robustness properties are particularly suitable to one of the biggest emerging markets for compact battery cells, that is mobile phones and laptop computer terminals.

By using a solid state polymer electrolyte the battery has the characteristics of being lightweight, with high energy that proportionately turns into long-life of up to 10 years. It is also easy and cost effective to manufacture and it is environmentally friendly.

Currently the market for batteries is split into two groups, primary batteries, the disposable ones, and the secondary batteries, the rechargeable ones. The total battery market by the year 2000 is predicted to reach a value of \$45 billion which will split equally in value over primary and secondary batteries. The market for high performance rechargeable batteries is estimated to be in excess of £4 billion and is growing fast. With a CAGR of 20 per cent its growth is closely linked with the rapid growth of cellular phones, laptop computers, camcorders and smart cards.

The lithium-ion solid polymer battery can handle up to 2,000 charge/discharge cycles and the actual achieved energy densities are related to the battery's discharge rate. Its energy density can be up to 125 Watt-hours per kilogram. The rechargeable battery can deliver two to three times as much energy as nickel-cadmium batteries of comparable size.

Length of operation before recharge is one of the most critical parameters when choosing a battery for any applica-

tion. The lithium-ion batteries can operate between two and four times longer than conventional carbon-zinc and alkaline primary batteries, depending on the application and operating environment. The batteries self discharge at less than 10 per cent per month and there is no memory effect. Batteries can be recharged after brief periods of use with no loss of capacity.

This type of battery is up to 25 per cent lighter than conventional primary batteries. The operating voltage of the cell is 3.5 V, which is nearly three times that of nickel-cadmium or nickel metal hydride cells, used in today's mobile phones. It can also be fully charged in an hour.

Other organizations which have been developing this kind of battery are the UK Atomic Energy Authority's R&D facility, AEA Technology and the US-based Valence Technologies. AEA Technology was developing a more efficient cell for electric vehicles.

Valence last year was in a deal with Motorola to develop a large quantity of lithium-ion batteries for Motorola's cellular phones. However, Valence failed to deliver on time leaving Motorola searching for the next technological partner to develop solid state polymer batteries.

Ultralife's CEO Bruce Jagid said that the company had recently won an exclusive contract from a large telecommunications company to supply up to 10 million lithium-ion polymer cells over the next three years, which he confirmed will be used in cellular phones. But Jagid would not confirm whether this was the Motorola contract.

Ultralife's expertise comes from many places and in June last year it acquired UK-based Dowty Batteries of Abingdon. Before the acquisition, Dowty was part of the TI Group. It manufactured a variety of lithium batteries and it was renowned as the world's largest producer of seawater batteries. Dowty was particularly strong in the research and development of advanced-technology lithium batteries, an expertise that was transferred to Ultralife with the acquisition.

"Dowty's assets blend perfectly with Ultralife's short- and long-term strategies. The combined resources create a strong company ready to introduce an exciting new technology for the next generation of wireless electronic products", said Jagid.

The buy-out had a double effect. With the injection of cash that Ultralife brought into Dowty, the turnover increased, the number of employees went up and the company is looking forward to increasing its production capacity from 1,500 cells per day to 5,000. There is talk of further expansion and the possibility of Abingdon being turned into a major manufacturing site within the next 12 months.

"Now we are the fastest growing battery manufacturer in the UK. And with the support we are getting from Ultralife this trend will continue", said David Goodwin, managing director of Ultralife (UK).

The development of lithium-ion cell technology for the mobile phone market was an important factor in the Dowty acquisition. Ultralife recognizes the strength of the European market where cellular technologies are moving fast and is considering the possibility of manufacturing lithium-ion cells in the UK.

"We would like to see a manufacturing facility for solid state batteries in the UK. The tendency is that we will build it in Abingdon because from there we can support

Europe", said Jagid. (Source: *Electronic Weekly*, 5 April 1995)

Osaka University develops CLBO crystal for sensing element

Professor Tomotaka Sasaki *et al.* of Osaka University, College of Engineering, Department of Electrical Engineering, have succeeded in developing a selenium-lithium-borate (CLBO) crystal which converts infrared lasers into ultraviolet lasers. It has a high performance, covering the defects of conventional wavelength conversion crystals, including a broad area of short wavelength conversion up to 213 nanometres. Focusing on short wavelength conversion of solid infrared lasers such as neodymium YAG lasers instead of excimer lasers, which have a problem of longevity at present, would be linked to implementation of a fully solid-state ultraviolet laser.

CLBO crystalline growth was achieved by the top seed growth method in which boron oxide, lithium oxide and caesium oxide were mixed at a fixed proportion and heated to a temperature of 850° C. Professor Sasaki discovered that CLBO has the optical characteristic of generating ultraviolet rays upon laser input to CLBO crystals. Moreover, a short wavelength of 266 nanometres to 213 nanometres was the output in the ultraviolet range. Crystalline growth is also very rapid, and the researchers succeeded in growing ultra-large crystals of 10 cm² in 10 days. The conversion efficiency of these crystals is in the class of second harmonic generation (SHG) devices, but they have been confirmed to have higher crystalline cutting properties and impact resistance. The wavelength of infrared lasers could be shortened to the ultraviolet range by stacking two or three CLBO devices. In addition, the wavelength conversion efficiency rises as higher-output lasers are input.

A solid-state neodymium YAG laser using a semiconductor laser as the excitation source is in the infrared oscillation wavelength, but barium or borates, which shorten the wavelength to the ultraviolet wavelength, can achieve a 200 nanometre wavelength. However, the wavelength conversion is obstructed when greater power is input to raise the conversion efficiency, and the problem of laser optical absorption arises.

Furthermore, lithium borate has the defect of inability to output at wavelengths shorter than 300 nanometres, and the crystalline growth is slow. Growth of a large crystal is difficult, which makes it unsuited for commercialization.

However, solidification of an exposure light source for ultra-fine processing equipment becomes possible since a short wavelength ultraviolet laser, which was impossible using lithium and borate, can be generated by combining CLBO with a neodymium YAG laser. Pattern transfer technology at the 0.15 micron level is necessary for the development of one gigabit class ultra LSI, and the practical application of exposure technology based on X-rays and ultraviolet lasers is anticipated.

Excimer lasers have been applied practically at present in the ultraviolet range, but problems remain associated with industrial utilization, including use of fluorine gas, short equipment life, and excessive enlargement of equipment. The advantages in terms of life and size would be expanded if it were fully solid-state, and it would be expected to have great advantages in ultra-precise machining, material surface improvement, optical moulding, material synthesis in medical applications in addition to micro-

machining equipment for semiconductors. (Source: *Nikkan Kogyo Shimbun*, 1 February 1995)

Shimadzu mass produces solid-state blue laser

Shimadzu Seisakusho, Ltd. will commence the mass production of a solid blue laser. Production will commence at the Atsugi Factory in Kanagawa in September 1995 on an annual scale of a few thousand units. The solid blue laser is expected to serve as the next generation of optical devices, but there have been few examples of its commercialization. Shimadzu will take the lead in commercialization even though it comes from a different area of industry, that of medical and measurement equipment.

The laser to be mass-produced is a 473 nanometre short wavelength solid-state blue laser "solid state 473". There are two types, a standard type having a 10 milliwatt output and a low noise type with percentage difference in output stability, and sample shipments have already commenced.

The yield has been raised through design ideas implemented in manufacturing procedures. It will start mass-production and commercialization as the industry leader after reaching the prospect of a price level of argon lasers. Making good use of its advantages of small size and long life, it aims at the broad demand for optical sources in high-density storage equipment, micromachining equipment for semiconductors, medical equipment and analysis/measurement equipment.

The blue laser of this company excites a YAG crystal, the active material, using a near-infrared semiconductor laser to radiate 940 nanometre laser light. Short wavelength light of 473 nanometre wavelength could be obtained by inserting a gallium niobate crystal, which is a second harmonic generation (SHG) device. Continuous oscillation of 32 milliwatts, the highest reached so far, was achieved at the laboratory level through design ideas applied to an optical resonator with good mode match between laser light and excitation light, and applied to the design of lenses which focus excited light. (Source: *Nikkan Kogyo Shimbun*, 11 February 1995)

MITI to develop four-dimensional computer

An outline for a "four-dimensional computer" that Japan's Ministry of International Trade and Industry (MITI) will begin building during 1995 describes a super-parallel computer of individual microprocessors (MPU) with combined arithmetic and communications functions. The world's first optical wiring will be mounted onto the core central operations structure. The Real World Computing Program (RWCP) has been commissioned to research and develop the computer through a 10-year project that began in 1992. MITI plans to utilize the completed four-dimensional computer to accelerate research and development on human-life flexible information processing functions.

During early 1995, the RWCP will develop an MPU meant exclusively for a super-parallel computer with arithmetic processing and high speed communications functions. Construction of the computer itself will begin later. 604 MPUs will be built into a rectangular parallelepiped 1.5 metres long, 1 metre wide, and 0.8 metres deep; the computer will be operated by linking two of these together.

In order to carry out high speed transmission of data between the microprocessors, optical wiring will be employed in one part of the central operations structure. This

will be the world's first mounting test for optical wiring. The mounting range will be expanded as test results are checked, and MITI would like to shift all wiring to optical communications in the future.

Software development is continuing at the same time. In addition to the basics such as the operating system (OS) and programming language, scientists are trying to develop a way to integrate information so that it can be understood by combining characters and pictures, much the way a person would read a comic book.

As improvements are made in the four-dimensional computer itself, the number of MPU will gradually increase as well. Ultimately, the system will be expanded to one in which 1 million MPUs are theoretically possible. MITI is promoting a "Joint Optoelectronics Project" with the USA as the RWCP's optical technology link; the US Department of Commerce is directing its attention to the results of optical technology that Japan has taken on first.

The "four-dimensional computer" is a project that aims to realize information processing functions with nearly human flexibility, by merging super-parallel computer technology with various types of advanced technologies such as optical technology, neural networks, and fuzzy logic. (Source: *Nihon Kogyo Shimbun*, 26 January 1995)

JESSI partners develop XRF wafer analyser

To meet the growing need for more accurate wafer analysis in IC production, four JESSI partners developed an X-ray fluorescence (XRF) wafer analyser that allows the precise determination, to a few ppm or better, of almost any element from beryllium to uranium.

The analyser, dubbed the SPW2800, is easy to use for a range of process components (e.g. silicides, phosphorus-doped polysilicon and aluminium based metallization). It is especially useful for BPSG in which the B and P concentrations are critical. The analysis and BPSG thickness can be performed in under three minutes with an accuracy 10 times better than production tolerances.

In XRF spectrometry, electrons in the sample are excited by X-rays. The electrons lose energy, emitting fluorescent X-rays with wavelengths specific for each element and virtually independent of the molecular configurations. Analysis is performed by wavelength measurements by crystal diffraction.

The technique was established by Philips in the early 1950s, but four years of testing were required to show it is ideal for wafer analysis. It is especially useful for the control of uniformity across the whole surface area of 200 mm wafers.

The analyser, developed by LETI, Philips Analytical X-ray, Philips Research and SGS-Thomson, is designed for mounting into a cleanroom wall, with only the wafer loader open to the cleanroom area. (Reprinted with permission from *Semiconductor International Magazine*, March 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA)

Crolles benefits from combined expertise to advance CMOS, BiCMOS process control

Impressive achievements in advanced CMOS and BiCMOS processing were announced by the 200 mm wafer joint research and manufacturing centre run by three industry and government organizations in Crolles, France.

After the qualification of two 0.5 μm CMOS and two 0.7 BiCMOS processes in 1994, processing of the first

0.35 μm CMOS prototypes has started. This centre will be among the first in the world to provide 0.35 μm devices.

The best available equipment was introduced into the line immediately after its industrial maturity was proved—thus achieving process control an order of magnitude better than older technologies.

Although gate oxide thickness in the Crolles double gate oxide process is determined by four independent process steps, uniformity is remarkably good; a statistically significant number of lots in the line show thickness variations of about 0.7 nm.

Extreme care has been taken to provide an ultra-clean environment. In tests carried out with a 200 mm horizontal wafer in a fully operational cleanroom, only one particle was added to the wafer every three days.

The Crolles facility derives benefits from the combined expertise of its three participating organizations: SGS-Thomson, Philips and CNÉF (Centre National d'études des Télécommunications, France Telecom).

Crolles is unusual in that IC development and production are fully integrated and use common development and pilot production teams. This is said to allow optimum preparation of processes in the technology development phase and very rapid transfer of know-how to production. (Reprinted with permission from *Semiconductor International Magazine*, March 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA)

IBM microelectronics researchers develop a decal solder bumping process

Researchers at IBM Microelectronics, Endicott, NY, have invented what they term "a simple, high yield method" to add controlled amounts of eutectic solder to flip chip attach (FCA) carrier pads.

The method is based on electroplated "non-wettable" substrates (decal). Reporting on the results recently, Ramnath Venkatraman, Miguel Jimarez and Kenneth Fallon claim the technique is viable for both chip attach and chip rework processes for COB applications. (Extracted with permission from *Semiconductor International Magazine*, March 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA)

French develop thin plastic transistor

Workers at the French National Centre for Scientific Research have developed a metal-free plastic FET. It is claimed this device can be used to produce circuits that are thinner than a sheet of paper. Tracks made by inks containing graphite are employed instead of conventional metal conducting links. Thin layers of different materials are deposited by printing techniques.

The organic transistors thus produced can handle high currents, yet they can be bent, or even twisted through 90° without their electrical properties being noticeably affected. This technology is expected to enable various economical devices to be produced as flexible sheets, perhaps eventually even leading to computers that can be rolled up.

This work is believed to be the first use of purely organic polymers as the active layer in electronic devices. All earlier devices have used metallic parts. Traditional high temperature and high vacuum equipment may be eliminated. (Reprinted with permission from *Semiconductor International Magazine*, March 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA)

Low-power transistor developed

Philips Research Laboratories, Eindhoven, the Netherlands, has developed a lateral bipolar transistor structure on SOI (silicon-on-insulator) with a polysilicon emitter for ultra-low power use.

The researchers showed excellent devices with emitter areas down to 0.15 μm^2 , with scaled junction capacitances and with f_t values of up to 15 GHz. Portable telecommunications equipment uses seem likely.

These devices are fabricated using IBIS SIMOX SOI material with a top silicon thickness of 250 nm doped with arsenic to 10^{18}cm^{-3} . After isolation of the transistors by etching excess silicon, a 400 nm TEOS layer is deposited and patterned to form an oxide block whose width determines the width of the collector drift region. The collector contact area is implanted with phosphorus to $5 \times 10^{21}\text{cm}^{-3}$ and self-aligned with respect to the oxide block. A resist mask prevents phosphorus implantation into the base area.

The process requires only seven masks with just one critical step and single metallization. The sheet resistance of the n⁺ collector contact layer is only 20 Ω/sq . This layer can be used as a local interconnect level in many applications. The device exhibits a nearly constant current gain at $I_c = 1\text{ pA}$, indicating low defect densities in the silicon and at the buried-oxide/silicon interface. Much shallower bases should be achievable by lateral diffusion of the base from a p-type source. (Reprinted with permission from *Semiconductor International Magazine*, March 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA)

NO to make sub-5 nm oxynitrides

Australian researchers at the School of Microelectronic Engineering, Griffith University, Nathan, Australia, have investigated the use of NO as the nitrogen source in the manufacture of oxynitride films. Oxynitrides are seen as potential replacements for SiO_2 films for tunnel dielectric in EEPROMs and as gate oxides in MOSFETs, due to their improved dielectric integrity and hot carrier reliability.

Previous research examined thermal nitridation of thin SiO_2 in ammonia (NH_3) and, more recently, in N_2O . Unfortunately, ammonia-grown oxynitrides were reported to show degraded mobility due to the heavy nitridation and increased electron trapping due to the incorporation of hydrogen atoms. N_2O -grown oxynitrides show good electrical characteristics, but have insufficient nitrogen (~1-2atm%) at the dielectric-silicon interface to prevent boron penetration.

The Australian researchers (led by Z.-Q. Yao) also found that it is not possible to obtain good quality films below 4 nm using N_2O .

The new studies using NO have shown excellent results: the oxynitrides have higher nitrogen concentration in both the bulk of the film and also at the dielectric-silicon interface. NO-grown films are also superior in terms of leakage current, interface state density and electric stress-induced degradation. The researchers say their 3.2 nm films had a leakage current at least three orders of magnitude lower than that reported for NH_3 -nitrided and pure SiO_2 films of the same thickness.

The films were grown by rapid thermal nitridation using 99.0 per cent NO at 1150° C for 1 to 5 minutes. (Reprinted with permission from *Semiconductor International Magazine*, February 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA)

Stepping up to the 256 Mb DRAM chip

Samsung Electronics in the Republic of Korea has used SVG Lithography's (SVGL) Micrascan II step-and-scan photolithography system in the development of the world's first 256 Mb DRAM chip. Samsung officials report that the application and technical support from SVGL were a valuable contribution to their project.

The machine-to-machine overlay and large field size of the Micrascan II allows Samsung to meet the stringent sub-micron design rule requirements of the 256 Mb DRAM; the system has an overlay accuracy of better than 70 nm at 3 sigma. By coupling high resolution, low distortion, and a unique focusing and levelling capability with a 22 mm by 32.5 mm field, Samsung has been able to produce this sophisticated device. (Extracted with permission from *Semiconductor International Magazine*, February 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA)

Watching IC current with tiny magnets

A team of researchers at Sandia Laboratories' Electronic Components Center has developed the first practical, non-invasive method for detecting and imaging currents in operating ICs. The method uses magnetic force microscopy (MFM), a scanning probe microscopy technique, to detect and image the magnetic fields produced by internal currents in operating ICs.

Both current and voltage imaging of internal conductors on operating ICs are feasible by combining this new current contrast imaging (CCI) technique with conventional electron-beam voltage contrast methods or with scanning probe microscopy-based voltage contrast techniques.

The Sandia team has shown that MFM-based CCI detects and images current magnitude and direction or phase in IC conductors with a current sensitivity of approximately 1 mA for direct current and approximately 1 μ A for alternating current. The spatial resolution ranges from a few micrometres to submicrometres, depending upon the sensor used for the measurement.

The researchers are now concentrating on developing large-area scanning capabilities so that an entire chip can be imaged. They are also refining scanning probe microscopy technologies for voltage measurement and applying both current and voltage imaging techniques to the diagnosis of chip failures. (Reprinted from permission from *Semiconductor International Magazine*, February 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA)

Turning amorphous silicon into polysilicon

AMLCD manufacturers in Japan, Korea and the US are working with a laser annealing technique pioneered by XMR Inc (Santa Clara, Calif.) that allows them to convert amorphous silicon into polysilicon. This could lead to substantial savings in that it enables the use of a low-cost glass instead of quartz substrates when fabricating high resolution polysilicon thin-film transistor displays. Polysilicon enables faster transistor switching speeds and allows them to fabricate the display "drivers" on the glass substrate along with the TFTs.

Since a low temperature, large area polysilicon deposition process has yet to be developed, most displays today are fabricated of amorphous silicon and the driver chips are bonded to the glass and connected by Tape Automated

Bonding (TAB). A study by David Sarnoff Laboratories showed the cost of an on-glass driver was about \$3, compared to about \$100 to \$120 for TAB drivers.

XMR says the advantage of laser annealing is that the shortwave uv laser energy is intensely absorbed by the amorphous silicon, quickly turning it into polysilicon without affecting the glass substrate underneath.

The laser annealing system includes a proprietary 150 W XeCl excimer laser, and a subsystem that synchronizes beam delivery with the substrate handling system. Another unique feature is an optical train homogenizer that turns the quasi-Gaussian intensity profile into a "top hat" profile, scanning a spatially uniform and rectangular beam over the substrate. XMR can also provide a cassette-to-cassette handling system for automatic loading and unloading of substrates with an hourly throughput of up to 20 360x450 mm substrates. (Reprinted with permission from *Semiconductor International Magazine*, February 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA)

Optical trapping of metal particles

Researchers at the Institute for Advanced Materials Processing, Tohoku University (Japan), have succeeded in trapping metal particles with a laser beam. The "optical tweezers" can hold microscopic metal particles without mechanical contact.

Conventional implementation of laser trapping has been applied only to a transparent object such as a living cell or a sphere of glass or polystyrene. This is because capturing and levitating the target takes advantage of the two different forces generated when the incident beam enters and exits the target. The conventional method must also scan the laser beam in a circle.

The new method can easily trap and carry one or more opaque particles of metal, such as gold, silver or bronze, previously thought almost impossible. It uses the force generated when the incident laser beam is reflected by the target metal particle.

In the new method, a metal particle is suspended in water, and a tens-of milliwatts laser beam is focused around the particles by an objective lens with a large N.A. The granule is trapped in a spot a little above the focus. In the laboratory, the new method could trap and horizontally move metal particles 1-10 μ m across with the exception of a few metal materials.

Theoretical analysis predicts that the method may be applied to semiconductors if the laser wavelength is adapted. The new laser scheme is a promising general way of trapping every microscopic particle from a living cell to a metal particle.

Researchers of micromachines now have a process for fabricating microscopic components, and are waiting for a totally non-contact method of trapping and transporting such components. It seems that the new method will greatly ease the assembly of microstructures, and will support the forthcoming technology.

Further details from: Institute for Advanced Materials Processing, Tohoku University, 2-1-1, Katahira, Aoba-ku, Sendai City, Miyagi Pref. 980-77; Tel: +81-22-227-6200. Fax: +81-22-261-0938. (Source: *JETRO*, March 1995)

Disk type AC electrostatic actuator

Professor T. Higuchi (Tokyo University) and his research team of the Kanagawa Academy of Science and

Technology have developed a disk type AC electrostatic actuator whose rotor is driven by electrostatic force. This actuator consists of a rotor with radially arranged three-phase electrodes and a stator with electrodes of the same construction.

Two polymer films each mounting radially arranged electrodes are counterfaced, and a torque is generated by utilizing the attraction and repulsion forces between the three-phase electrodes when AC voltages are applied to the electrodes. The prototype actuator has a diameter of 2 cm, weighs about 0.3 g, and has a maximum power of 36 mW, so is lighter and generates a bigger torque than the conventional type of small motors. The new actuator is expected to be an excellent drive system for compact disks.

The actuator drive unit (rotor) is made of a polyamide film 0.1 mm thick and weighing 0.13 g, which is the same kind of material as that of the printed circuit substrates fitted into cameras, and a total of 192 electrodes are arranged radially on a ring-shaped stator with an inside diameter of 12 mm and outside diameter of 18 mm. The film backside has three concentric ring electrodes which come into contact with electrodes called brushes to receive AC voltages of different phases and send the voltages to the radial electrodes. A stator fitted radially with electrodes in the same way is arranged counterfacing this rotor, and the rotary force is generated by the electrostatic force that acts between the rotor and stator.

Performance tests showed that the torque generated by the prototype actuator was a maximum of 0.7 Nm, the power density per kg was 140 W, and the speed was a maximum of 3,900 rpm. Both rotor and stator are very light and thin, so the actuator is usable as in compact disk players which use electromagnetic motors to enable downsizing and weight reduction.

Further details from: the Kanagawa Academy of Science and Technology, 3-2-1, Sakado, Takatsu-ku, Kanagawa Pref. 213; Tel.: +81-44-819-2048, Fax: +81-44-819-2095. (Source: *JETRO*, March 1995)

Capacitor for large-capacity 1-Gbit DRAMs

NEC Corporation has established technology for forming capacitors applicable to the manufacture of large-capacity 1-Gbit DRAMs. A strontium titanate (SrTiO_3) film, a ferroelectric material, is formed on a ruthenium dioxide (RuO_2) electrode by the electron cyclotron resonance chemical vapour deposition (ECR-MOCVD) process. This technology allows capacitors to be produced with an area of $0.125 \mu\text{m}^2$, electrode height of $0.5 \mu\text{m}$ and cell capacity of 25 fF for manufacturing 1-Gbit DRAMs.

The new capacitor has a construction in which the surface of a rectangular parallelepiped electrode with a bottom area of $0.125 \mu\text{m}^2$ and height of $0.5 \mu\text{m}$ is coated with a highly dielectric strontium titanate film as thin as 40 nm. The electrode material is ruthenium dioxide of excellent workability in place of platinum used up till now.

Heating to about 600°C is necessary for forming a strontium titanate thin film, which causes deterioration of the performance of the element, so had not been used till now. NEC applied the ECR-CVD process of reacting the raw material gas by plasma excitation for forming the film, and established technology to form excellent superthin films by stepped coating for forming the necessary film.

As a result, the electrode lateral faces can store electric charges, and the cell charge storage capacity deterioration has been suppressed. Compared with the tantalum oxide

film that is the main ferroelectric film for 1-Gbit DRAMs, the strontium titanate film has a higher dielectric constant, corroborating that even a superfine cell is capable of displaying adequate charge storage capacity.

Testing the prototype capacitor showed that the charge storage capacity is 25 fF/cell. A 1-Gbit DRAM requires a capacity that is at least 20 fF to prevent misoperation, so the new capacitor has an adequate capacity allowing commercialization.

Further details from: NEC Corporation, Public Relations Division, 5-7-1, Shiba, Minato-ku, Tokyo 108-01; Tel.: +81-3-3798-6511, Fax: +81-3-3457-7249. (Source: *JETRO*, March 1995)

Plasma spraying process for superconductive magnetic shielding on large containers

The National Research Institute for Metals (Science and Technology Agency), Mitsui Mining and Smelting Co., Ltd., and Nippon Keiki Work, Ltd. have jointly developed a new production method for superconductive films to be used in large magnetically shielded containers, which are indispensable for determining weak magnetic fields such as those radiated from human brains. The new method takes advantage of the plasma spraying process to lay a superconductive magnetic shield film on a container substrate.

Plasma spraying is a film deposition method by which film material is heated by a very hot arc discharge to form a plasma, which is bombarded onto a target surface, where the plasma is cooled to make a film. The process can produce an extensive, thick, yet homogeneous film in a short time. The process works well with a target body of any shape or dimensions. Because the arc discharge concentrates on a small zone of source material, the production efficiency of the film is very high. The process is a good way to cover plastic products with non-abrasive metal film.

The research team envisages applying the new process to medical equipment by measuring weak magnetic fields from human brains.

Further details from: National Research Institute for Metals, Science and Technology Agency, 2-1, Sengen, Tukuba City, Ibaraki Pref. 305; Tel.: +81-298-53-1187, Fax: +81-298-53-1199. (Source: *JETRO*, March 1995)

Gallium-arsenide LSI for 10-Gbit/s optical communications

Ok Electric Industry Co., Ltd. has developed a next-generation gallium-arsenide (GaAs) LSI for 10-Gbit/s optical communications. This LSI integrates about 7,000 transistors on a 16-mm^2 GaAs wafer, has a switching speed of 10 billion per second, and is applicable to optical communications with an information transmission speed of 10 Gbit/s.

In optical communications, the information carried by a laser beam is converted into electric signals with an optoelectronic integrated circuit (OEIC), then processed with semiconductors. The new LSI is for processing these electric signals transmitted by the OEIC, and divides the 10-Gbit/s signals into eight parts of 1.25 Gbit/s each for simultaneous parallel processing. The 16-mm^2 LSI consists of about 7,000 Schottky gate field effect transistors (MESFETs) with a minimal line width of $0.5 \mu\text{m}$.

Further details from: Ok Electric Industry Co., Ltd., Public Relations Department, 1-7-12, Toranomon, Minato-ku, Tokyo 105; Tel.: +81-3-3501-3111, Fax: +81-3-3581-5522. (Source: *JETRO*, March 1995)

Large semiconductor wafer carrier

Mitsui Toatsu Chemicals, Inc. has developed a large semiconductor wafer carrier (PEEK Wafer Carrier) made of the superengineering plastic polyether ether ketone (PEEK). A carrier for 6-inch wafers is to be marketed in the early part of 1995 and another for 8-inch wafers to enable the handling of all wafers within the range of 4-8 inches.

The wafer carrier is a container accommodating silicon wafers on which printed circuits are to be engraved in the process of manufacturing semiconductors. Up till now, carriers made of fluororesin or metals were used, but with wafers becoming increasingly larger, from 6 inches to 8 inches, the existing carriers are frequently deformed by heat, and there was also the problem of impurities being generated, such as dust and gases, with the large-scale integration of ICs.

A carrier made of PEEK features an excellent thermal resistance and is usable in an environment of up to 220° C, and has an excellent wear resistance, so eliminates the problems associated with dust due to friction with wafers and gas generation from the carrier itself. It also features an excellent rigidity and so retains dimensional stability over a long period. The weight can also be reduced by 40 per cent compared to carriers made of fluororesin. In addition, the company plans to mix carbon to form an electric charge inhibition type that features the characteristic of preventing electric charges semipermanently.

The company plans to export these wafer carriers to the USA, the Republic of Korea and Taiwan Province of China, where semiconductor manufacturers are achieving remarkable growth.

Further details from: Mitsui Toatsu Chemicals, Inc., 3-2-5, Kasumigaseki, Chiyoda-ku, Tokyo 100; Tel.: +81-3-3592-4735, Fax: +81-3-3592-4256. (Source: *JETRO*, March 1995)

Chemists develop cobalt clusters

Chemists at the University of Wisconsin (Oshkosh) have developed an efficient process for the synthesis of disk-shaped cobalt nanoclusters that may be useful in the construction of high-density recording media such as videotape or computer disks. The ferromagnetic nanoclusters—which are 100 nanometres wide and 15 nanometres thick and possess a single magnetic domain—are synthesized through the high-frequency ultrasound waves of a cobalt ion-hydrazine solution. The nanoclusters can be stored between synthesis and application and orient spontaneously when deposited on a polymer film. The researchers have not yet filed for a patent but believe this is the first process of its kind. (Source: *Chemicalweek*, 22 March 1995)

Scientists combine inorganic and organic molecules

Scientists from IBM's Yorktown Heights, NY laboratory and chemists from the University of Houston's Texas Center for Superconductivity have mixed tin and iodine with compounds of hydrocarbons and nitrogen to form new materials that will help researchers understand how to develop novel electronic and non-linear optical devices for computers and other uses. In addition to searching for superconductors, scientists will be able to demonstrate how organic compounds of this structure can control the properties of inorganic chemicals. Inorganic materials, such as

silicon, are easy to make into electronic devices, but it is difficult to fine-tune such properties as conductivity. (Source: *Chemicalweek*, 22 March 1995)

Buckyballs learn new tricks

Scientists at Northwestern University (Evanston, IL) have developed a technique to assemble fullerenes in ordered rows in a single molecular layer on gold surfaces. The researchers say such monolayers could have applications in developing materials for catalysis, magnetic materials and electronic devices. Meanwhile, fullerene researchers at the University of Basel say experiments have shown that the frictional properties of C_{60} can vary widely. The scientists studied the forces and behaviour of fullerenes deposited on a sodium-chloride substrate and found islands of C_{60} could be moved intact—a process that could prove useful in building nanoscale machines. In contrast, fullerenes on graphite could not be moved collectively. The frictional properties of fullerenes have gained scientific attention because of the materials' potential as novel lubricants. (Source: *Chemicalweek*, 4-11 January 1995)

Texas scientists probe single molecule

Chemists at the University of Texas (Austin) report developing a technique to observe the electrochemical behaviour of a single molecule in solution as it undergoes electron-transfer reactions. The scientists trap a small volume of a dilute solution of the electroactive species between an ultra-microelectrode tip and a conductive substrate. A scanning electrochemical microscope is then used to probe the oxidation of [(trimethylammonio) methyl] ferrocene. (Source: *Chemicalweek*, 1 March 1995)

Smart gels

Japanese researchers have developed a sponge-like polymer gel which can contract in just 20 minutes rather than months. Such gels could be useful as "smart" actuators in temperature-sensitive switches or valves.

The material is a hydrogel—a tangled mass of polymer chains which can absorb many times its own volume of water. It only holds water within a certain temperature range: above 32° C it ejects the water and contracts. Current hydrogels take over a month to collapse, which limits their uses.

The Japanese team, from Tokyo Women's Medical College and Waseda University, have made a gel from cross-linked poly(*N*-isopropylacrylamide). In most hydrogels, all the polymer strands are cross-linked to other strands; there are no "free ends". This new polymer has comb-like side-chains which are only attached to the polymer framework strands by one end.

When gels without side-chains collapse, the team explains, they form a "shell" which slows the solvent's escape. But when the new gel is warmed above 32° C and starts to shrink, the side-chains move closer together and soon form hydrophobic clumps. These simultaneously bring the main chains of the network into closer contact, and squeeze more water from the inside of the gel. (Source: *Chemistry & Industry*, 20 March 1995)

Large display system using small neon lamps as light source

CRC Co., Ltd., a developer and marketer of large display systems, has developed a large display system called C'Reactive Vision that uses small neon lamps as the

light source. The images are clearer than the display systems using light-emitting diodes (LEDs), and the manufacturing cost is about the same as that of producing LED displays.

The display system consists of a front panel, its control system and an input editing system for image information such as characters and images. The front panel generally has a maximum width of 14 m and a height of 8.4 m and, in this case, a panel consists of about 15,360 basic units (cubical elements). Small red, green and blue U-shaped neon lamps are arranged in matrix form and these neon lamps are controlled with a low voltage to display characters and images clearly on the entire panel in colour.

The LED is capable of displaying images only in the three colours or in orange, but the neon lamp enables display in as many as 256 hues, allowing clear display of not only characters and still pictures, but moving images as well. CREative Vision is an aggregation of dots arranged in matrix form, and each dot is an RGB neon lamp on a single module.

Further details available from: CRC Co., Ltd., 1-15, Wago-shin-machi, Ogaki City, Gifu Pref. 503; Tel.: +81-584-82-7311, Fax: +81-584-82-7313. (Source: *JETRO*, March 1995)

Prototype single-electron transistor with microfine silicon structure

NTT Corporation has used a silicon insulating film implanted wafer (Separation by IMplanted OXygen wafer, SIMOX wafer) to fabricate a prototype single-electron transistor (SET) that operates at 27° C.

The SET that controls a single electron by utilizing the quantum effect is attracting attention as a transistor that paves the way for the commercialization of superlow power consumption, superhigh density LSIs. By utilizing the SIMOX wafer and the thermal oxidation process, a super-miniature insular structure was prepared and the SET working performance at room temperature confirmed. The SIMOX technology and a silicon superfine processing technology were applied, and the static capacitance, the factor determining the upper-limit working temperature, was decreased to 1/50th of the value regarded as the limit up till now.

Further details available from: Nippon Telegraph and Telephone Corporation, Press Relations, Public Relations Department, 1-1-6, Uchisaiwai-cho, Chiyoda-ku, Tokyo 100; Tel.: +81-3-3509-3101, Fax: +81-3-3509-4290. (Source: *JETRO*, March 1995)

Temperature sensing thermistor 0.5 mm thick

Ishizuka Electronics Corporation, a leading manufacturer of thermistors using temperature sensors, has developed a superthin thermistor for sensing the temperatures of battery packs and chargers of personal computers.

The thermistor is used to check the state of normal charge and discharge of batteries by monitoring the temperature, but those now in wide use with a thickness of about 2 mm are incapable of responding to the needs of battery packs which are increasingly compact.

A distinct characteristic of this new thermistor is the remarkable thinness of 0.5 mm, about one-fourth that of conventional counterparts, for the recent manufacture of ever smaller and thinner electronic circuits for use inside battery packs. The company plans to supply the thermistor

to battery manufacturers from early 1995 and to manufacture 2,000,000 thermistors monthly during the year.

Further details available from: Ishizuka Electronics Corporation, 1-7-7, Kinshi, Sumida-ku, Tokyo 130; Tel.: +81-3-3621-2704, Fax: +81-3-3623-7776. (Source: *JETRO*, March 1995)

Single-chip image processing LSI

Hitachi, Ltd. has integrated a special-purpose LSI that incorporates an image processing circuit for the expansion and contraction as well as contrast adjustment of image information photographed with a charge-coupled device (CCD).

The new image processing LSI ISP-X measures 3 cm on all sides and displays the same functions as an image processing circuit previously etched on a board measuring 30 cm on all sides.

ISP-X incorporates an interface circuit capable of directly linking inexpensive DRAMs as image memory elements. Up to four image memory channels can be handled, each capable of working with a maximum of 64 images comprised of 512x512 pixels. It also incorporates an interface circuit for controlling the frame memory that exchanges data with a camera or a monitor, so simple colour processing is possible in real time.

Further details available from: Hitachi, Ltd., Public Relations Secretary's Office, 4-6, Kanda-Surugadai, Chiyoda-ku, Tokyo 101; Tel.: +81-3-3258-1111, Fax: +81-3-3258-5480. (Source: *JETRO*, March 1995)

Visual sensor with sensitive central spot

Professor Y. Suematsu and a research team at Nagoya University have developed a visual sensor system that works like the human eye. The cornerstone of the system is a row of seven lenses arranged to provide the system with an extensive visual field in which the picture is enlarged at the centre, and compressed in the outer part. Besides the lenses, the system consists of a commercially available CCD (charge-coupled device) camera, an image recorder, an image processor and a microcomputer. Visual information collected by the lenses is processed by the electronics for the system to emphasize the noticeable centre area in the visual field.

While having an extensive visual field, the new system achieves adequate high resolution in the central area. However, only necessary information is brought into the data processing controller. As a consequence, the system works well with less pixel information in a picture than ever. The unprecedented system has promising applications in, among others, monitor cameras, robots and automobiles.

Further details available from: Nagoya University, Department of Electronic-Mechanical Engineering, The Faculty of Engineering, Furo-cho, Chikusa-ku, Nagoya City, Aichi Pref. 464-01; Tel.: +81-52-789-2769, Fax: +81-52-789-3124, E-mail: sue@nuem.nagoya-u.ac.jp. (Source: *JETRO*, March 1995)

Compact pulse laser with maximum output of 400 W

Sumitomo Electric Industries, Ltd. has developed a compact pulse laser generating system with a maximum output of 400 W, the highest in Japan. The oscillation wavelength is in the infrared domain of 1.53 μm , so it is safe to the eyes.

The laser has a width of 12 cm, a depth of 9 cm and a height of 4 cm (only optical switch and fibre unit). The excitation light source is a semiconductor laser of 1.48 μm . An optical fibre is used whose laser activation substance contains erbium.

The pulse laser is capable of generating pulsating light of about 400 W at 2,000 Hz with peak power, and the pulse width is 20 ns, making it suitable for measuring numerous points. The laser uses optical fibre, so it is a compact, high-output laser generating system, and is a low-power consumption type that can be driven with a battery.

As the light is safe to the eyes, the pulse laser is applicable to overhead power transmission lines and to laser-based measurement systems to measure the distances of trees, and since the oscillation wavelength is in the bandwidth that minimizes the optical fibre loss, it is also applicable to various systems using optical fibres.

Further details available from: Sumitomo Electric Industries, Ltd., Administrative Department, 4-5-33, Kitahama, Chuo-ku, Osaka City, Osaka 541; Tel.: +81-6-220-4119, Fax: +81-6-222-3380. (Source: *JETRO*, March 1995)

New chemical purification of carbon nanotubes

H. Iwasaki and M. Yumura and their research team at the Chemical System Department of the National Institute of Materials and Chemical Research (NIMC), Agency of Industrial Science and Technology (AIST), have developed a new chemical method of purifying carbon nanotubes. Because the crude product of carbon nanotubes contains impurities, purification including heat treatment is required. The new method features a purification temperature some 200° C lower than the conventional method. Lower treatment temperature may allow smaller nanotubes to remain as produced.

A carbon nanotube consists of carbon atoms bonded together to make a circular structure with a diameter of one to tens of nanometres. The structure has a central hole passing through, forming a configuration of a hollow cylinder as the name implies. Because the new material seems to have new properties, many researchers have started investigations. However, there has been no definitive way to isolate and purify carbon nanotubes. The new method will provide researchers with a reliable purification process, so that the exact properties can be determined. Applications to semiconductors and functional materials will be easily investigated.

The new method is also said to be reproducible, even by inexperienced researchers. Every purification result is reliable.

Further details available from: National Institute of Materials and Chemical Research, AIST, 1-1, Higashi, Tsukuba City, Ibaraki Pref. 305; Tel.: +81-298-54-4729, Fax: +81-298-54-4487. (Source: *JETRO*, March 1995)

CVD system for rapid forming of polySi TFT gate insulating films

ULVAC Japan Ltd. has developed a plasma enhanced chemical vapour deposition (PECVD) system using TEOS gas for the mass production of the gate insulating films indispensable for the polySi thin film transistors (polySiTFT) large-scale liquid crystal display (LCD). The silicon dioxide (SiO_2) insulating film is formed in a more dense plasma discharge to improve the deposition rate onto

glass substrate to about 10 times that of conventional processes.

The channels through which electrons pass, the channel layers inside LCD TFT (thin-film transistors), are primarily amorphous silicon films in notebook type personal computers. However, large LCDs for high-vision display will require an increasing number of pixels using a polySi silicon film featuring a liquid crystal display response speed that is more than 100 times faster. Moves by electronic manufacturers to develop large LCDs using poly-SiTFT need a technique for the mass production of the gate insulating films used in the switching region.

The new PECVD system is for manufacturing polySiTFT used in large-scale LCD. The company has fabricated a PECVD system called CMD-450 Poli that incorporates the new technology and has started accepting orders for the new system.

Further details available from: ULVAC Japan Ltd., Electronic Equipment Division, 2500, Hakizono, Chigasaki City, Kanagawa Pref. 253; Tel.: +81-467-83-1151, Fax: +81-467-58-5773. (Source: *JETRO*, March 1995)

New polymer sensors

Physicists at Trinity College have devised a new kind of polymer sensor that they say is cheap and easy to mass-produce, and has potential applications in a wide range of industries.

The new sensor uses an old material, specifically, polyurethane yacht varnish, but in a radically new kind of way. The researchers have developed techniques which enable them to produce very thin films of the varnish to specified depths. The nature of the polymer in the varnish is such that the path of light through it can be controlled. Shine a beam through a very thin film of the varnish, and the light will be guided internally. Alter the thickness of the film and you can produce a film that will no longer guide the light internally. That is the principle of the new sensor.

The film can be used to detect pressure changes (which would alter the thickness of the film) as well as sound, temperature changes and changes in air flowing over it—basically, anything that will distort the film. The yacht varnish is extremely durable and, depending on the substrate to which it is applied, it can also be very flexible.

Dr. W. Blau and the TCD team developed techniques for controlling the deposition of the varnish in very thin layers while working on a project for ALPS in Millstreet. The work, funded by the Higher Education-Industry Cooperation (HEIC) fund, was aimed at developing new techniques for producing computer and TV screens.

According to Dr. Blau, the fact that the new sensors can be cheaply and easily manufactured makes them ideal for applications like avionics, where many sensors are used. Additional advantages of the new technology are that the sensor film can be placed at the end of an optical fibre, so that it can be used at a distance, and that no electricity is used, making them ideal for applications in hazardous conditions. (Source: *Technology Ireland*, March 1995)

New ferroelectric memory technology

Sharp Corporation has developed the first technology that enables greater memory densities in ferroelectric memory chips of up to 1 Mbit.

In contrast to conventional planar structures that place the capacitor alongside the transistor, the new configuration

comprises a three-dimensional structure (stacked-capacitor design) in which the capacitor is stacked on the transistor contacts making it possible to arrange a greater number of ferroelectric memory cells in the same amount of space.

A precision sub-micron process based on 0.6-micron design rules creates the features that form the capacitor.

Ferroelectric random access memory (FRAM) is a new memory that has properties of both a read-only memory (ROM) and a random access memory (RAM). Like a ROM, it is non-volatile and information stored in the device is not lost or erased when the power supply to the device is cut; like a RAM, data can be written and read from the device at high speeds.

FRAM is expected to find broad application in portable information devices and memory cards, as the main memories for portable computers, video memories and in the field of magnetic storage media.

Further details available from: Sharp Corporation, Corporate Public Relations Division, 22-22, Nagaike-cho, Abeno-ku, Osaka 545; Tel.: +81-6-621-1221, Telefax: +81-6-628-1653. (Source: *JETRO*, February 1995)

Full CMOS technology for SRAM cells in logic LSI

Fujitsu Ltd. has developed full CMOS technology for SRAM cells embedded in 0.25- μm logic LSIs, which will reduce the production cost. The technology uses simplified fabrication processes, and the circuit area is reduced by putting local interconnection wires directly on the gate pads, so eliminating the dielectric layer. The new technology squeezes a 6-component SRAM cell into an area as small as 10 μm^2 .

The new SRAM technology is intended for memories in logic LSIs. Because such memories must be fast, free from soft errors and compatible with the whole logic circuit in the fabrication process, the company chose the 6-component configuration of the SRAM cell to be made smaller. The achievement is attributed to new techniques for local interconnection, self-aligned contacts, ion doping pad material, etc.

The local interconnections are formed of titanium nitride (TiN) in the cross-coupling that has a wire to go across a gate and then connect with another gate. The TiN local interconnection is also applied to locations where wires are too close to each other in logic gates. The local interconnection pattern is deposited directly on the diffusion layer and gate pads with no dielectric interlayer. Unlike the conventional aluminium interconnection, the new technology requires no marginal area for contact holes, allowing circuits to be smaller. The local interconnection is a very thin film so that the process does not require flattening of the circuit surface, and so has fewer steps.

According to the company, the new technology promises to become a cost-efficient method of fabricating extremely high-density SRAMs, which will constitute most of the 30 million devices integrated with the 0.25- μm logic LSI.

Further details available from: Fujitsu Limited, Public Relations Department, 1-6-1, Marunouchi, Chiyoda-ku, Tokyo 100; Tel.: +81-3-3213-4160, Fax: +81-3-3216-9365. (Source: *JETRO*, February 1995)

Superprecision aluminium cold strip forging technology

Industrial moves to manufacture electrical and electronic equipment of ever greater compactness and higher

performances require the performances of heat sinks to catch up with the increased heat generated by the structural parts of this equipment, posing a serious technical problem. Lowering of equipment prices is in progress, but there is no outlook for substantial cost reduction in the manufacture of heat sinks by conventional processes, such as cutting, forging, welding and press forming, so that the cost of moulds is becoming a heavy burden especially when producing products in small lots.

Alpha Co., Ltd., a precision forger of aluminium automobile, electrical and electronic parts, has established a superprecision aluminium cold strip forging technology for forming 621 pins, each with a diameter of 0.8 mm and height of 25 mm, on a 60-mm² wafer, and has decided to mass produce high-performance heat sinks with these pins. Manufacturing is accomplished rapidly and economically, so the technology enables the manufacture of compact CPUs and LSIs and large electronic equipment, such as inverters for use in cooling.

Ordinarily, a larger load is impressed on the mould for more accurate and complicated forging operations, and the mould is fractured when the limit is exceeded. The new technology uses a special heat treatment to enable the mould to be used for precision forging and to improve the lubricating film on the target forging surface, by which the load on the mould is decreased.

Manufacturing with this new method enables the forming process to be shortened to 10-30 s to enable mass production at a low cost. As for the performance, a thermal resistance of 1.2-1.5° C/W was obtained when directing an air flow of 2 m/s.

The new technology has enabled the development of four types of heat sinks: 621 round pins of 0.8 mm at 2.8-mm gaps on a 60-mm² wafer (thickness of 3.5 mm), 324 square pins of 1.2 mm at 3 mm height, 100 blade type fins 1 mm wide and 9 mm long, and 121 star-shaped pins with hold diameters of 2 mm.

Further details available from: Alpha Co., Ltd., Thermal Division, 2570, Ipponmatsu, Numazu City, Shizuoka Pref. 410-01; Tel.: +81-559-66-0789, Fax: +81-559-66-9192. (Source: *JETRO*, March 1995)

Micro-generator with 1.2 mm diameter

Mitsubishi Electric Corporation has experimentally fabricated a micro-generator with a diameter of 1.2 mm. A miniature coil was prepared by applying the processing technology used in the manufacture of super LSIs and permanent magnet rods with runners incorporated inside. Revolving the runners generates a voltage on the millivolt level.

Feeding the micro-generator into the body of small chemical plant pipes, and utilizing the flow of blood or air to revolve the runners, enables the micromachine to be utilized as a power source.

The cylindrical micro-generator is about 1.8 mm long with a diameter of 1.2 mm. A runner is provided at the tip of the rotary shaft inserted in the cylinder centre. Positioning the generator in a flowing gas or liquid revolves the runner and generates electricity.

The greatest difficulty was encountered in the coil fabrication. The generator as a whole is cylindrical, six rectangular plate coils are used in combination, and the entire assembly unitized by coating with an alloy. The stator consists of a winding and a magnetic core, requiring the generator to be cylindrical while securing a sectional

area allowing the conductive parts of the windings to achieve a high space factor, increasing the number of turns, and attaining a high magnetic core performance. A model of the conductive parts was fabricated by forming the polyamide insulating layer 2 μm wide, 10 turns were wound in spiral form on the conductive part with a sectional area of 7 x 15 μm by electrolytic copper plating, and formed into two layers to fabricate the winding consisting of 20 turns. The area space factor is about 70 per cent.

Research on the cylindrical stator concentrated on the method of forming the windings on the magnetic core with an outside diameter of 1 mm and a length of 0.5 mm in the axial direction length. The core mould was formed by using a polymer sheet 50 μm thick as the mask and repeating the removal process 10 times. The winding is set in this mould manually, followed by permalloy electrolytic plating to make the stator. In experiments, the runner was revolved at 100,000 rpm and a voltage on the millivolt level generated.

This research project was advanced by the Micromachine Center under consignment by the New Energy and Industrial Technology Development Organization (NEDO) as a link of the Micromachine Technology Research and Development Project. The project was actually conducted by Mitsubishi Electric Corporation under reconsignment by the Micromachine Center.

Further details available from: Mitsubishi Electric Corporation, Public Relations Department, 2-2-3, Marunouchi, Chiyoda-ku, Tokyo 100; Tel.: +81-3-3218-2172, Fax: +81-3-3218-2431. (Source: *JETRO*, February 1995)

Carbon fibre used as negative electrode material of lithium ion secondary battery

Toshiba Corporation has developed the first type of carbon fibre that is usable as the negative electrode material of lithium ion secondary batteries, which are the next-generation version of high-performance secondary batteries.

As a result, and compared with the lithium ion secondary batteries in wide use today, the electrical capacity has been increased by 20 per cent with battery charging time shortened to one hour, less than one-half compared to before. Use enables portable information processing terminals, such as personal computers, to operate longer and with greater ease.

The Materials & Devices Research Laboratories of Toshiba's Research & Development Center have developed a mesophase pitch carbon fibre with a diameter of 10 μm and a length of 60-70 μm . The mesophase pitch is a substance formed by heating heavy oil at a temperature of about 400°C, and has characteristics of both solid and liquid substances. The fibre is produced by spinning this material into fibre form, followed by heating.

The mesophase pitch-based carbon fibre has an excellent electrical conductivity and molecular structure with regular alignment. It is capable of storing and releasing a larger volume of lithium ions than particulate or spherical carbon substances with a diameter of about 10 μm consisting primarily of graphite or cokes which have already been commercialized for use as a negative electrode material. In addition, it has a faster charge and discharge speed, and great strength, elasticity and durability.

The lithium ion secondary battery (diameter 18 mm, height 65 mm) using this new carbon fibre for the negative electrode provides an excellent performance, a voltage of 3.7 V, electrical capacity of 1,400 mAh, and volumetric energy density of 310 Whr/l. Other than the voltage, the performance is 20 per cent better than those of popular counterparts.

Further details available from: Toshiba Corporation, Public Relations Office, 1-1-1, Shibaura, Minato-ku, Tokyo 105; Tel.: +81-3-3457-2100, Fax: +81-3-3456-4776. (Source: *JETRO* February 1995)

Solar battery with high energy conversion efficiency

Japan Energy Corporation has developed a solar battery featuring the highest light-electric energy conversion efficiency in Japan. The compound semiconductor single-crystalline tandem type solar battery is produced by fabricating an indium-gallium-phosphorus (InGaP) solar battery on a gallium-arsenide (GaAs) battery. Compared to conventional types, the energy conversion efficiency has been improved by over 5 per cent to as high as 27.3 per cent, and the interfaces have been optimized to enable the maximum utilization of the intrinsic characteristics of the two components.

The new solar battery has been fabricated by applying the compound semiconductor single-crystalline technology, by which the full characteristics of the semiconductors are displayed. This solar battery uses two different types of solar batteries, a GaAs solar battery and an InGaP solar battery, mounted on a GaAs battery by the epitaxial growth process. The characteristics of the two materials are utilized fully to enable the solar battery to capture light over a broad range of wavelengths.

The energy conversion efficiency of the new solar battery is less than that of a tandem type made in the USA, but the standard battery area has been increased by over four times to 1 cm x 1 cm. This considerably improves the conversion efficiency (15-20 per cent) of silicon single-crystalline solar batteries presently under commercialization. In addition, since the battery is highly resistant to radiation, it is usable on space satellites. (Source: *JETRO*, February 1995)

Single-chip low-noise amplifier for millimetre wave communications

Mitsubishi Electric Corporation has developed a single-chip low-noise amplifier (monolithic microwave integrated circuit, MMIC) for millimetre wave communication systems that can transmit huge volumes of information. It works on frequencies in the millimetre-wave band of 90 GHz and is capable of amplifying signals by about seven times. This is the first monolithic millimetre wave amplifier communications system.

The MMIC consists of two high electron mobility transistors (HEMTs), microstrip lines, resistors and capacitors. The company succeeded in accommodating these components on a single gallium-arsenide (GaAs) chip 1.2 mm long and 2.6 mm wide by applying the superfine processing technology. The gate length of this HEMT has been reduced in size to only 0.15 μm to enable high-speed operation. In addition, a selective etching of dielectric film mounted on the gate has been developed in the process of manufacture to prevent degradation of the HEMT low-noise performance. These improvements succeeded in retaining

the excellent amplification performance in the millimetre-wave frequency band when assembling a monolithic amplifier.

The new MMIC is to be incorporated as a principal component into a microwave and millimetre-wave radiometer to be mounted on the Advanced Earth Observing Satellite (ADEOS-II) scheduled for launching into orbit by the National Space Development Agency of Japan (NASDA) in FY 1998.

Further details available from: Mitsubishi Electric Corporation, Public Relations Department, 2-2-3, Marunouchi, Chiyoda-ku, Tokyo 100; Tel.: +81-3-3218-2172. Fax: +81-3-3218-2431. (Source: *JETRO*, February 1995)

All-polymer transistors put silicon in the shade

At least five major electronics firms are developing products based on all-polymer transistors, amid claims that the technology could eclipse amorphous silicon in applications such as flat panel displays and smart cards by the end of the century.

Matsushita and Mitsubishi, Motorola, IBM and Philips are all working on all-polymer transistor systems. Matsushita and Mitsubishi have already published research papers on the subject, and Mitsubishi is rumoured to be very close to the world's first all-polymer transistor based flat panel display prototype for laptops.

Flexible polymer transistors have been pioneered by a team of researchers at the CNRS centre in France, led by Francis Garnier. The French team has been working on the devices for the last five years, but now the technology is being taken up by electronics giants world-wide.

The main advantage of polymer transistors over silicon ones is their mechanical flexibility, which may allow complete bending or rolling without affecting their electrical properties. They should also be cheap to make in volume, and the devices can be made transparent, suitable for windshield applications in aeroplanes and cars.

At present polymer transistors are slower, larger and have lower output current than silicon transistors, but these characteristics are expected to be improved with further development. Garnier expects the first commercial products, probably in the form of displays for domestic appliances, as soon as 1996/1997. (Source: *Electronics Weekly*, 22 March 1995)

Samsung samples monolithic flash

Samsung Semiconductor says it has begun sampling the world's first monolithic 32 Mbit flash memory chip. The 3.3 V only KM29V32000 device is of the NAND architecture type developed by Toshiba and licensed to Samsung. Samsung makes the chip on a half-micron process.

The chip is erased in blocks of 8 Kbytes. A block erase takes 6 ms; the whole chip is erased in 10 ms. Read time is 50 ns. Samsung guarantees 10,000 erase/write cycles per block and expects over 100,000.

Samsung says that a 64 Mbit device will be out next year. (Source: *Electronics Weekly*, 22 March 1995)

Sony stretches optical lithography to 0.1 μm

Sony has combined two leading edge chip fabrication devices, a quadrupole light source and a phase shift mask, to stretch optical lithography towards 0.18 μm feature fabrication. This is the feature size that will be needed to

make the first generation of 1 Gbit DRAMs in production quantities.

The surface of a wafer is not flat, but deviates up to 1 μm . The image of the production mask must be in focus for all "altitudes" on the wafer surface, therefore the projection optics must have a "depth of field" (DOF) of 1 μm minimum.

The size of image that can be clearly focused onto the surface of the wafer is proportional to the wavelength of light used. For 0.35 μm lithography (current state-of-the-art for production) specially developed krypton fluoride (KrF) excimer lasers are used that emit ultraviolet light at 248 nm (0.248 μm).

For a given optical system both the minimum image size and the DOF are proportional to wavelength. These limitations restrict KrF lasers to feature sizes of 0.35 μm .

Beyond the DOF a circular spot projected on the wafer becomes a larger and larger circular blur.

Sony has used a trick to reduce the effect of this problem by altering the characteristics of the laser beam.

Sony's modified optics split the laser beam in four, diverge the sub-beams using a prism array, then recombine them, creating a quadrupole light source. This replaces the normal circular light source with four smaller overlapping ones. In sharp focus, the new image looks like four spots, but outside the DOF the blurred image has more energy in the centre and looks much more like a "normal" focused spot.

This technique raised the effective DOF more than two times, allowing the optics to be changed, trading the increased DOF for smaller feature size.

If a feature size of 0.28 μm is required, conventional illumination only gives a DOF of 0.77 μm . The new source gives a 1.1 μm DOF, just suitable for production techniques of the near future.

The second feature Sony has incorporated is a phase shift mask. A normal mask has transmissive and non-transmissive regions. The sharp transitions between these regions result in diffraction patterns over the wafer surface around the image. Diffraction effects can be reduced by deliberately phase shifting light by different amounts at different points in the mask.

There are some limitations to phase shift masks, not all image shapes can be made and there can be a strong secondary image next to the primary one. On their own phase shift masks can improve image resolution, but the quadrupole light source can be optimized to suppress most of the secondary image.

The new light source and mask together allow 0.22 μm features with a 1 μm depth of field.

Sony has demonstrated that its combination technology can produce 0.22 μm features and claims it can be developed to make first generation 0.18 μm chips using optical lithography. (Source: *Electronics Weekly*, 22 March 1995)

First 0.1 μm devices

The world's first working devices built using 0.1-micron lithography are expected to be made later in 1995, pushing silicon switching speeds close to 100 GHz.

The devices will be produced at the extreme ultraviolet lithography facility opened at Sandia National Laboratories, California, in a collaboration between Sandia and AT&T's Bell Laboratories.

A fast field effect transistor is expected to be the first device produced, with a 0.1 micrometre gate. The transistor, measuring about 10 micrometres across, should run at 90 GHz.

The facility uses light with a wavelength of 13 nm, in the extreme ultraviolet or soft X-ray region of the spectrum. (Source: *Electronics Weekly*, 8 March 1995)

Micromachined relays

Analogue Devices is to develop micromachined relays with a consortium, including Northeastern University and three automatic test equipment (ATE) manufacturers: Megatest, Schlumberger and Teradyne.

Micromachining is a technique where microscopic mechanical components like gears, levers and springs are made on the surface of silicon substrates using chip fabrication techniques.

Fundamental research will be carried out at Northeastern with production support at Analogue Device's Wilmington, Massachusetts, site. Analogue Devices already manufactures micromachined accelerometers for use in automotive air bags. (Source: *Electronics Weekly*, 8 March 1995)

Lowdown on the cellular

What is a cellular phone? Cellular mobile phone technology was first developed by scientists at Bell Telephone Laboratories in the United States in 1979 but was initially written off as unviable. But its competitors in Scandinavian and Japanese companies continued to work on the idea and produced an economically and technically viable system in 1980. By 1981, the world's first mobile phone service had started functioning in Japan and some Scandinavian countries.

Cellular phones take their name from the transmission networks which are arranged in radio cells, several cells making up an individual network.

Mobile phone technology has undergone a dramatic change since it was invented. In early days, there were analogue networks which meant that they broadcast radio waves in analogue form which usually resulted in distortion of signals and noise. Connection with land-based telephones was also difficult. In the late 1980s, a consortium of European companies devised a digital version of phone technology, christened GSM (group special mobile), which is a global standard today.

At the heart of the mobile phone service is a master switching centre which helps to set up a call, route it to the receiver, control it and then terminate it. The individual user connects to the master switching centre through a base station. The base station is similar to the master switching centre and receives, switches and retransmits a call to a specific number. But what it cannot do is to determine where a user is moving. This information is detected by the master switching centre which then "hands over" a call from one cell to the cell into which the user has moved. Such "handovers" are the basis of the cellular mobile phone system.

It is estimated that there are over 75 million mobile phone users around the world and their number is growing at over 30 per cent per annum. Experts feel the number of mobile phone users could cross the 1,000 million mark by the year 2005 (Source: *Deccan Herald*, 15 May 1995)

Switching speed for 500 Gbit/s data rate

Researchers at the Electro Technical Laboratory in Japan have recently developed an "Auston" switch that can produce electrical pulses only 570 fs in duration. This very fast electro-optical transducer opens up the prospect of communication at data rates above 500 Gbit/s.

The switching element is a gap only 100 nm wide between the ends of two titanium strips laid down on the surface of a special gallium-arsenide substrate.

The switch is triggered by a laser pulse, only 40 fs long, which is focused onto the GaAs surface through the gap. The incident energy causes electron-hole pairs to be formed in the substrate, briefly connecting the ends of the strips together. The narrow gap and the special cold grown substrate, which ensures that residual pairs recombine rapidly, ensure the switch turns off again in less than 600 fs.

Actual measurement of the switch closure time is performed using a lithium tantalate crystal connected to the switch by a transmission line. The electrical pulse from the switch passes under the crystal changing its refractive index. This change is detected using light pulses from the same laser.

The switch is constructed by depositing a 4 nm thick layer of titanium onto the GaAs surface. The gap in the strip is formed by oxidizing a line of titanium 100 nm wide by drawing the tip of a scanning probe microscope over the surface. The probe is electrically negative with respect to the titanium layer, promoting the oxide formation.

Two strips of titanium, at right angles to and touching the ends of, the oxide line are then etched away. This leaves two areas of titanium either side of the strip electrically isolated from it.

This strip is interrupted by the oxide line. One end of the strip is connected to a bias voltage, the other is connected to ground through a terminating resistor. The remaining residual areas are also connected to ground. The strip of titanium with the surrounding grounded areas forms the transmission lines.

This switch cannot be used as a receiver in current optical communications systems because light from existing optical fibres has insufficient energy (the wavelength is too long) to trigger the switch. Development of an effective optical "up converter" is needed before the switch's full potential can be realized. The only current practical use is as a detector in nuclear accelerators where the electron-hole pairs are formed by particles passing through the substrate. (Source: *Electronics Weekly*, 8 March 1995)

High resolution ADC beats world

Data Conversion Systems, a small UK chip design company based in Cambridge, anticipates having commercial samples of its world-beating 500 kHz 14-bit ADC by late 1995.

The single chip should be the industry's first monolithic ADC to offer a 14-bit 500 kHz performance. It will cost significantly less and have a higher reliability than the hybrid ADCs currently available.

The ADC employs the classic two-stage residue architecture in which the output digital word has been converted from the analogue input in two halves. However, clever circuit design and the incorporation of signal processing techniques have meant dramatic silicon area savings and an

enhanced dynamic range. (Source: *Electronics Weekly*, 8 March 1995)

New step-and-scan lithography technology

Technologists from Nikon (Tokyo and Belmont, Calif.) have revealed a new exposure technology that could, at the turn of the century, significantly impact the accelerating cost of production lithography. Briefly, the technology uses deep-UV exposure and scans a 4X image through a slit in a reduction stepper lens.

Nikon foresees the natural progression of optical lithography moving to scanning deep-UV stepper exposure. Its new scanning technology, however, is different from existing concepts. It is a refractive optical system that uses a slit through the "sweet spot" of a conventional stepper lens. According to Nikon officials, the advantages of this technology include progression to larger field sizes, without impacting the size of lenses. In addition, the technology improves distortion and total focal deviation because of the smaller effective "slit" projection lens and averaging effects of scanning. Perhaps most important, this new technology should improve cost performance, or slow the acceleration of lithography costs compared to leading-edge step-and-repeat technology. (Reprinted with permission from *Semiconductor International Magazine*, January 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA)

Molecules to shrink electronics

Feature sizes on chips could reduce from micrometres to nanometres following developments in molecular chemistry.

Several groups of researchers around the world are working on molecules that not only have the potential to shrink electronics but also make themselves from other molecules in simple chemical processes.

Professor Fraser Stoddart's group at the University of Birmingham's School of Chemistry have developed rotaxanes. These are chemicals whose molecules can exist in two switchable states and are therefore capable of storing binary information.

Rotaxane molecules have two parts, a rod, shaped like a dumbbell, and a bead, shaped like a ring. The bead is looped over the rod and can slide along it, but can only rest at one of two active sites. The bead is moved from one site to the other by chemical (adding a proton), electrical (adding an electron) or optical (adding a photon) means. Once the bead has changed site it will remain fixed until it is moved back again.

Dr. Steve Langford, a member of the Birmingham team, said "The beauty of rotaxane is that the bead naturally threads itself onto the rod, forming it is almost as simple as mixing solutions of the component molecules together".

At this time the molecules are being experimented on in solution, where millions of them are changed from one state to the other at the same time. In solution the state change can be detected by various means including optical spectroscopy as some rotaxanes change colour dramatically when they are switched.

Applications can be envisaged where rotaxanes or some other molecule exhibiting two or more fixed states are designed to naturally assume positions in a two- or three-dimensional matrix. The matrix could form the core of a very dense memory. (Source: *Electronics Weekly*, 1 March 1995)

High density MCM

A Massachusetts company, Integrated System Assemblies (ISA), has developed a multichip module (MCM) technology that allows large numbers of chips to be incorporated in a small package, such as a fully functional solid-state recorder, with control and refresh logic, that can store more than 15 sec of uncompressed, full-motion video data.

The module contains 1 Gb of DRAM in a space 3 in² in area and 1.5 mm in thickness. By comparison, the IC industry is working to put 1 Gb of memory on a single chip—but these will not be in production for another five or six years.

ISA backgrounds commercially available off-the-shelf, 16-Mb DRAMs and ASICs to a uniform thickness, then mounts them on a substrate before building an interconnecting circuit layer over them. After the substrate is removed by laser, the resulting ply—less than 0.5 mm thick—contains an entire MCM that can be laminated with other MCMs in stacked assemblies of up to eight plies.

The interconnects are made of sputtered copper, 25 μ m wide and 6 μ m thick, with 75 μ m pitch. The dielectric is a spin-coated polyamide with a dielectric constant of 2.8. Conventional chip connection methods such as wire bonds have been eliminated.

With 88 per cent of the MCM consisting of active silicon, ISA says their devices are three to 10 times more efficient in space utilization than the best competing technologies and are ideal for space-constrained applications, such as miniature video recorders, hand-held computers, pages and credit-card-size PCMCIA cards. (Reprinted with permission from *Semiconductor International Magazine*, January 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA)

World record for hard disk drive density

IBM has claimed yet another world record for data storage density, demonstrating in its research laboratory a disk drive with 3 Gbits of data per square inch—five times the current density of hard drives.

To put the data density achievement in a more understandable perspective, IBM says that 375 average length novels could be stored in a single square inch of disk surface.

IBM says that producing the new drive did not require any exotic new technologies and was achieved by using improved versions of IBM's magnetoresistive recording heads and ultra-low noise thin-film magnetic hard disks.

At this high density, IBM says that its current high end disk drive, the 2.5 in Travelstar low profile format drive, could hold as much as 3.4 Gbytes of data compared to its current capacity of 720 Mbytes.

The 3 Gbit demonstration stored bits at a linear density of 180,000 bits per inch on concentric tracks of 16,500 per radial inch. Each data bit is stored in an area 5.6 millionths of an inch long—about one quarter of the area found in optical storage disks.

The hard disk is an aluminium platter coated with a thin film of magnetic cobalt alloy, covered with a protective hard material. This enabled data to be stored and read at a rate of 4.5 Mbytes per second using IBM's partial response, maximum likelihood (PRML) recording channel rather than a conventional peak detection channel. Data error rates were one in ten billion, which IBM says can be reduced to one in ten trillion using standard error correction codes. (Source: *Electronics Weekly*, 5 April 1995)

Brainwaves control PCs

Two US studies suggest that brainwaves can be amplified and used to control computers.

Doctors in New York have succeeded in teaching subjects to manoeuvre a cursor on a display screen up and down and from side to side. EEG signals from the subject's brain are transmitted to an amplifier, which boosts the signal. This signal is passed to a PC, which analyses the signal and focuses on a particular wavelength to control the cursor.

A separate Air Force study has made use of a phenomenon called visual-evoked response. Fluorescent lights mounted on either side of a subject's head are set to flicker 13 times a second. This causes the natural sine wave emission of the brain to synchronize itself with the lights.

With practice, subjects can vary the intensity of these provoked responses, and a computer can translate these into simple movements of a flight simulator.

According to Dr. Jonathan Wolpaw, head of the New York State Health Department project, the hardware to put brainwave controls into effect exists, but it will take intensive analysis of the brain's electronic traffic and isolation of individual signals to make brainwave controls a practical reality. (Source: *Electronics Weekly*, 5 April 1995)

US researchers crack displays

Electronic displays based on particles suspended in a liquid could outperform today's active matrix liquid crystal displays (AMLCDs), according to a small US research company which claims to have solved one of the fundamental problems limiting the use of the technology to date.

Research Frontiers, based in Woodbury, New York, has developed prototype suspended particle displays (SPDs) in collaboration with a team headed by Dr. Michael Lee at Imperial College in London. It says the displays are inherently brighter, have better contrast and viewing angles and should be cheaper to make than AMLCDs.

The displays are based on tiny rod-like particles measuring around 0.2 to 0.3 microns in length, suspended in a non-aqueous liquid held between two transparent substrates. Left to themselves the particles are randomly oriented and scatter light which falls on them. But an electric field applied between the substrates can make the particles line up, by inducing an electric dipole on them which then lines up with the field direction.

Light falling on the liquid in the field direction can then pass through without being scattered.

A crucial advantage of these displays over AMLCDs is that they do not need polarizers stuck to their surfaces, which absorb much of the light that falls on them. AMLCDs need polarizers because their switching effect is based on altering the angle of polarization of light. As well as improving their efficiency, and hence reducing the power of the backlight needed, the absence of polarizers should also make SPDs cheaper to produce than AMLCDs.

Earlier work on SPDs floundered because the particles tended to settle to the bottom of the liquid but Research Frontiers say the problem has been solved.

The first-generation prototype display measures 85 mm by 70 mm and consists of an active matrix of 340 columns and 280 rows. Imperial College's Thin Film Laboratory developed the switching matrix for the displays, based on transistors made of cadmium selenide.

The prototype displays cannot use silicon transistors because they need a switching voltage of 15 V or more and

also a very fast refresh rate. However, the switching voltage has now been brought down to below 15 V and it will be possible to use silicon transistors in future versions. (Source: *Electronics Weekly*, 22 February 1995)

NTT puts solitons to work on 80 Gbit/s data stream

Solitons, those illusive optical pulses measuring a few picoseconds in duration, have been put to work carrying an 80 Gbit/s data stream over 500 km of fibre by the Japanese telephone operator Nippon Telegraph and Telephone (NTT).

Solitons are not easy to produce and the Japanese system required a specially developed optical amplifier using a mode-locked optical fibre soliton laser, a stable optical multiplexer utilizing a planar lightwave circuit (PLC), and an optical demultiplexer consisting of a non-linear optical loop mirror.

The mode-locked optical fibre laser detects part of the light (approximately five per cent) from the generated pulses themselves and feeds the detected signal directly back to the modulator. This technique minimizes waveform distortion and makes it possible to generate stable pulses over long periods of time at the extremely narrow width of 2-3 ps.

The soliton pulses travel down the fibre without changing shape even in the presence of dispersion. The width of a normal optical pulse expands due to dispersion, which causes different wavelengths to propagate at different speeds. The soliton's shape is maintained by a balance between the dispersion and the self-phase modulation effect, which changes refractive index in proportion to the intensity of the (incoming) optical pulse.

Optical multiplexing is used to achieve the full 80 Gbit/s throughput. Using wavelength division multiplexing in a specially developed optical switching circuit, 10 Gbit/s optical pulses are split into two, four and then eight, and are then superimposed with slight time differences to ultimately create stable optical signals at 80 Gbit/s. (Source: *Electronics Weekly*, 22 February 1995)

LSI claims integration lead for decoder sets

LSI Logic has used its CoreWare methodology, in which large blocks of predesigned circuitry are plugged together on a single die, to produce what it claims is the industry's most highly integrated MPEG-2 decoder chipset for Thomson Consumer Electronics.

The two-chip package, combining an existing LSI MPEG chip with a new front-end part, covers the entire signal processing chain in a digital satellite TV decoder, from demodulation of the QPSK high-frequency satellite transmission to generation of the CCIR601 video output ready for encoding into PAL, NTSC or SECAM formats.

The only missing block in the chain is the MPEG transport layer decoder, which Thomson has implemented in a separate ASIC. However, LSI says it will have its own transport decoder ready by the second quarter of this year. It will remain as a separate chip, said one LSI source, because integrating it onto the MPEG video and audio decoder would make that device uneconomically large.

The back-end video and audio decoder used in the TCE package is LSI's L64002 part announced last year, available on the merchant market. But the new front-end channel decoder chip is proprietary to TCE.

The million-transistor channel decoder combines four cores: a QPSK demodulator; Reed-Solomon and Viterbi error correction decoders; and a de-interleaver core that correct large bursts of data by isolating errors into smaller, more manageable segments. (Source: *Electronics Weekly*, 15 February 1995)

Making light of packages

Quality Technologies Corporation (QTC) has developed high voltage opto-coupler packaging technology. It is easier to make than conventional designs and has improved voltage isolation.

Traditional packaging positions the chips one above the other. Electrode separation and therefore the isolation voltage between input and output depends on bending the lead frame and bond wires accurately, which is difficult to control.

In the new system, called Optoplanar, the emitter and detector are positioned side by side. Electrode separation depends solely on the lead-frame dimensions, which are easy to control.

The emitter and detector no longer face each other. The optical connection is made with a solid transparent dome with a white reflective coating on the outside. From an optical point of view the dome resembles an integrating sphere that gives even illumination over the lead frame and allows some latitude on chip positioning.

The dome is made from a clear flexible encapsulant. The new plastic, called Sylgard 572, has been chosen for its tacky properties. It maintains close adhesion with the dome throughout the life of the component. The plastic is loaded with titanium dioxide, a filler with a high reflectivity.

The design offers 5.3 kV isolation in a normal width six pin DIL package. The efficiency lets emitter currents as low as 1 mA be used. Current transfer ratio is typically 33 per cent. (Source: *Electronics Weekly*, 15 February 1995)

Multibit flash moves closer to production

Intel engineers have revealed further details of its multilevel cell flash memory technology in a paper on a 32 Mbit flash that stores two logical bits per floating gate storage cell.

The firm sketched out its ideas on using more than two voltage levels within a single storage cell last summer. However, though the ISSCC paper detailed the circuit design, it is clear that Intel engineers are still working on a number of areas, such as the voltage references.

In operation the flash memory achieves a 32 Mbit storage capacity from a 16 Mbit device by employing four states, defined by four voltage levels, on the floating gate cell. Intel says the technique will be applied to memories destined for cost sensitive solid-state mass storage applications such as PCMCIA cards, digital audio and digital photography. (Extracted from: *Electronics Weekly*, 15 February 1995)

Hot spotters wing it

Combining beauty with engineering, integrated circuit engineers at a US university are studying the wings of butterflies to learn how to manufacture semiconductors immune to localized hot spots.

Researchers at Tufts University are studying how heat travels through thin layers of materials, such as silicon and

silicon oxide. Because of the thinness of the silicon films, "the traditional laws of heat transfer fall apart", said Ioannis Miaoulis, dean of the College of Engineering. "We have found through our work that if the films are as thick as the wavelength of the incident radiation, then small changes in the thickness make a big difference in how much of the heat is irradiated or reflected, which means that small variations in the thickness of a film could cause big hot spots in the film as you manufacture it and damage the wafers", he said.

Once that concept was understood, the researchers looked to see if nature had used that principle. Miaoulis said the team discovered that the scales on a butterfly's wing are made from multilayer film structures. "In analysis we found that they have the optimal structures for absorbing and reflecting the sun's radiation", he said.

The team also observed that the scales on the wings are rough films and are investigating whether silicon films would be less susceptible to temperature variations during processing if they had thickness variations. (Source: *Electronics Weekly*, 8 February 1995)

High-temperature optical fibre developed

A resin-based optical fibre that can withstand temperatures up to 266° F has been developed by the Japan Synthetic Rubber Company, based on a material the firm developed in 1990. The company is working with Fujitsu to develop electronic systems based on the fibre for use in car engines and other high-temperature environments. (Source: *Electronics Weekly*, 8 February 1995)

PERM technology to father better disk drives

The Pre-Embossed Rigid Magnetic (PERM) media technology, which is the focus of a recent development and marketing agreement between Seagate Technology and Sony Corporation, is set to bring out high-quality, high-density, high-capacity disk drives that are easier and cheaper to make.

It is anticipated that 2.5 in disks with 15,000 tracks per inch (tpi) and data storage capacities of 1.5 Gbytes will be developed within the foreseeable future.

The current prototype PERM-disk has 5,000 tpi and 200 Mbytes of data storage, significantly higher than a conventional hard disk platter with 3,000 tpi and 80 Mbytes of data storage.

The difference between the conventional disk platters and a PERM disk drive is in the material used and in the method of production.

Instead of using glass or aluminium, as in the conventional drives, the material is plastic which has been pre-embossed with data tracks and servo-marks of size 5 x 0.6 µm and separated by grooves. This is achieved by the same technique applied in mastering and stamping compact discs.

After the actual surface has been prepared, it is covered with a magnetic layer and signals are written only on the top surfaces of the data tracks. As the servo-marks have concave or convex shape, each is magnetized with a different polarity.

The tracks are then read by high-sensitivity magnetic heads with improved eccentricity tolerance (more than 50 µm) and accurate positioning.

Using CD manufacturing methods lowers the costs of hard disk manufacturing as there is no need to write track position data for each individual drive.

It also increases the track density as there is no need for guard bands between the tracks. The grooves embossed on the disk mould act as guard bands. (Source: *Electronics Weekly*, 1 February 1995)

The nanosled slips into action

The march of nanotechnology continues relentlessly, with nanotubes and other nanocomponents almost commonplace. Swiss nanotechnologists have now developed just the thing for the atomic-scale winter sports nut—the nanosled.

Developed by Roland Lüthi and his colleagues at the University of Basel's Institute of Physics, the sled is made out of that mainstay of nanotechnology, buckminsterfullerene molecules. Its inventors believe it could form the ideal nano-transport system, moving the tiny components of nanomachines into position.

The spherical shape and high rigidity of C_{60} make it ideal for an industrial lubricant. However, the Basel team found a different way to exploit these properties. Using vapour deposition techniques, they constructed "islands" of C_{60} on perfectly smooth planes of sodium chloride and graphite, and tried to move them with the probing tip of a specially-modified scanning force microscope (SFM).

On the salt surface, the team found that the islands not only stayed intact, but slid around with remarkably little friction. The sideways force needed to move them was about 7 nN; this makes the nanosled-salt combination an order of magnitude slipperier than any normal lubricant, says Lüthi. But on the graphite surface, the "islands" stuck firmly; probing with the SFM merely broke the bonds which held the spheres together.

Lüthi believes that this difference results from bonding between the C_{60} and the surface. On the NaCl plane, he says, the individual fullerene spheres might spin freely; this "inhibits the formation of direction-dependent bonding and minimizes slip-stick friction". However, graphite seems to behave like a metal surface—these "freeze" the fullerene molecules in place, which would increase friction. "We think that π -bonds might form between the fullerenes and the graphite", says Lüthi, "but we have not been able to prove that yet".

The low friction and cohesion of the islands is the key to the nanosled, says Lüthi. Larger molecules, such as biomolecules, "could be deposited on such a nanosled and then transported to a desired location". (Source: *Chemistry & Industry*, 2 January 1995)

Deciphering the noise of corrosion

American chemical engineers have discovered a way to identify two different kinds of metal corrosion. The technique can tell chemical plant operators where corrosion is occurring and when to replace corroded parts, allowing plants to be operated more efficiently.

Babu Joseph, Rudolph Motard and their colleagues at Washington University, St. Louis, used a signal processing technique called wavelets to spot pitting and crevices, two types of corrosion that other detection methods fail to pick up. However, it only works where metals are in contact with flowing liquids, such as in pipes.

When two identical metals are connected by wires and separated by a liquid containing corrosive substances, such as metal chlorides, they produce a mix of electrical signals or electrochemical "noise". Pitting or crevice corrosion in the metal surfaces produce characteristic signals which the new method can filter out from the background noise of

other, general corrosion. The team compared the results from wavelet analysis with examinations of the metals using an optical microscope and found that the corrosion patterns matched closely.

The wavelets are algorithms that interpret electrochemical signals through both time and frequency of occurrence. This means they can pinpoint the position and extent of corrosion in equipment. This is an improvement on the current method of Fourier analysis which gives half the picture by providing only a breakdown of signal frequency, says Joseph.

The researchers expect a wide range of applications for this technology, leading to a family of industrial "fingerprinting" devices for processes in chemical plants. Joseph envisages a complete corrosion-detection system comprising computerized sensors linked to wavelet software with the results interpreted by an artificial neural network. (Source: *Chemistry & Industry*, 16 January 1995)

Micromachined pressure sensor

Silicon micromachining has had a very limited impact, but as the ability to integrate micromachined structures with conventional electronic circuits increases, so does the technology's applicability.

A number of micromachined structures have made their debut in the past few years. A team from the Physical Electronics Laboratory in Zurich has built a miniature pressure sensor with integrated signal conditioning electronics on the commercial 1.2 μm AMS process.

The pressure sensor is a circular plate below which the substrate has been removed. There are four apertures on the plate's periphery giving access to the cavity. A heating element runs across the top of the plate.

In operation, the heater is activated and simultaneously behaves as a thermistor. The resistance is monitored and changes correlated with pressure levels due to the change in thermal conductance of the gap beneath the plate.

The signal conditioning circuit comprised two controlled current sources and an op-amp. The sensor can measure pressures between 100 and 10^6 Pa and required a heating current of 8 mA. (Source: *Electronics Weekly*, 11 January 1995)

Working towards portable flash

Flash memory has a distinct and growing role to play in electronic systems, but most manufacturers recognize it is unlikely ever to replace DRAM.

None the less, research progress continues apace to remove some of the limitations of flash storage—notably its requirement for a high-voltage programming supply and its lowly erase/write endurance—in order to make flash EEPROM more acceptable for portable systems.

Mitsubishi and Hitachi are collaborating on a high-density flash EEPROM type they call DINOR that utilizes Fowler-Nordheim tunnelling for both the erase and write operations. The companies feel the DINOR structure is their strongest candidate for a high-speed 3 V-only flash memory but the endurance needed to be elevated.

To attack this problem Mitsubishi engineers reports a switch to hot electron injection for the erase operation. However, the electrons were generated from the substrate—the n-well surrounding the p-type tub in which the cell is formed provides both well isolation and is the electron injector (emitter).

The result was a significant improvement in erase/write endurance at low voltages. The hot-electron scheme attained an endurance of 10^5 cycles with only a marginal drift upwards in the threshold voltage from 1.5 to 2 V. By comparison, the Fowler-Nordheim mechanism had little drift at 10^4 cycles but by 10^5 cycles the threshold voltage had risen to nearly 4 V—plainly unacceptable. (Source: *Electronics Weekly*, 11 January 1995)

Growing coils onto silicon

Micro Sensys, a German-based radio identification specialist, has come up with a simple, low-cost way of building coils onto chips—by growing them onto the silicon wafer and hence avoiding the traditional bonding processes. The monolithic microstructure that Micro Sensys has developed is used in RF chips for contactless smart cards and other identification and access control applications. It completely integrates all of the analogue functions: a high-frequency rectifier, antenna coil and an EEPROM on a single chip.

Apart from acting as a space saver, this microstructure cuts costs typically associated with mounting and connecting chip contacts and circuits in conventional devices. It also allows volume production of chips from a single

wafer. For example, up to a thousand RF-ID chips can be created on a six-inch silicon wafer.

Micro Sensys uses a modified straight wall bumping process. This process is normally used in tape automated bonding for chips with many contacts (between 200 and 300), as in flip-chips.

A single metal layer is applied to the silicon substrate in the form of "bumps", leaving tower-block-looking structures behind. This is achieved by raising the metal layer higher than the silicon substrate but still allowing passivation-layer channels to run in between.

The passivation layer is typically a silicon-nitrate or polyamide 20 μm thickness. Above the passivation layer and the active circuitry of the chip, another metal layer, usually copper, is applied by photographic electroplating. It is this layer that is the coil and which is connected to the chip circuitry on the first layer.

The coil is 5 μm wide, 20 μm high and the bumps are separated by 5- μm passivation channels. The chip uses 1.2- μm technology. The smallest monolithic structure so far produced is 3.5 mm x 3.5 mm in size, which makes it ideal for use in smart cards. The operating frequency for this chip is 4 MHz, but it will soon change. (Source: *Electronics Weekly*, 22 March 1995)

D. MARKET TRENDS AND COMPANY NEWS

Market Trends

European displays market to grow

The European displays market (including modules) is estimated to have approached \$3 billion—around 16 per cent of the world market, despite the heavy manufacturing and end-user base in Far Eastern countries. This market, according to a new report from *Elsevier Advanced Technology*, is set to grow by 15 per cent per annum.

Cathode ray tubes (CRTs) remain the dominant technology, retaining over 80 per cent of the market share, but over the next five years, competing technologies such as plasma display panels (PDPs), electroluminescent displays (ELDs), vacuum fluorescent displays (VFDs), light-emitting diodes (LEDs) and more significantly liquid crystal displays (LCDs), are set to make inroads into this figure, driven by the trend to smaller and more portable computers, terminals and other information systems. (Reprinted with permission from *Semiconductor International Magazine*, February 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA)

Modem manufacturers price war

The next two years could well prove to be a make-or-break period for many modem suppliers in the UK market. It is becoming increasingly difficult for modem vendors to differentiate their products on technological grounds alone, and while this may be good news for resellers and users, it looks as though vendors will have to mutate into something other than one-product companies to survive. Probably the first company to signal this shift was Hayes with its Millennium modem rack. US Robotics is trying out the corporate market with its new systems division. This is likely to create price pressure in the systems market and force smaller-scale manufacturers to seek out the protection of market niches, such as PCMCIA card modems and ISDN.

The trend towards building modems based on the same chipsets means that a modem manufacturer's ability to compete depends upon its buying power. A small UK-based company stands little chance of competing on price with manufacturing giants in the US and Taiwan Province of China. According to Clive Hudson, Managing Director of US Robotics, in order to be a player, you have to have world-wide branding and manufacturing. Hudson does not rate the chances of survival for his UK rivals in the low-cost modem market. He cannot see them generating enough profit for the necessary research and development.

According to Phil Benge, Marketing Director of Dataflex Design, modem manufacturers have suffered from the problem of sale or return. A manufacturer will push a product out to distributors and it will find its way onto dealers' shelves, but thanks to distributors' stock protection policies, if the product does not shift, six months later the manufacturer will be flooded with returned goods that are technically obsolete. (Source: *MicroScope*, 15 February 1995)

PC card market gets boost from portables

The PC card market is set for rapid growth over the next five years as users switch to portable computers and demand the same functions as in desktop PCs.

Market research firm Dataquest says that 3.4 million units of PC cards were sold last year, but adds that this is only a fraction of the 29.3 million units that will be sold annually by 1999.

Multifunction PC cards are the fastest growing category, growing by as much as 400 per cent in 1994 alone. The market leader in PC cards is Megahertz, with about 25 per cent of the market, followed by Intel with 16 per cent and Xircom with 11 per cent. (Source: *Electronics Weekly*, 12 April 1995)

On-line information systems reach consumer markets

Commercial on-line services such as (in the US) CompuServe, America Online and Prodigy now boast millions of customers, and new services are appearing almost daily. Each of the major providers overlap in some areas—all provide access to E-mail for example—but also excel in specific niches. Costs vary and depend on specific features accessed. The market is so competitive that most services can be sampled for a limited period, free of charge.

The software to use CompuServe must be purchased, but includes some credit against the first month's usage. It is menu-driven, but there is no robust graphical user interface. Another early entrant into the market was the Dow Jones Source, aimed at financial planners and investors. The user interface is based on command line input, and the commands are arcane. It does, however, provide the full text of many business newspapers and magazines. Various commercial databases are also available, but incur surcharges. Prodigy suffers from the major drawback of being slow: this is due to the time taken to download (unsolicited) graphical advertisements, which cannot be turned off. Perhaps the fastest growing service is America Online. The software, freely available from direct mail or magazines, has an excellent graphical user interface.

More recently, IBM has bundled access to its Advantis network with copies of *OS/2 Warp*. The network provides full Internet access using the SLIP protocol. After installation, the user can download network tools, including a World Wide Web network navigator.

The content of such services, as well as ease of access for new customers who may not be as computer-literate as early users, will ultimately determine their commercial success or failure. (Source: *NFAIS Newsletter 37(2)*, February 1995)

Chip makers revise forecasts

Chip expectations for the third successive year are causing semiconductor industry analysts to hurriedly revise their market forecasts for 1995.

Motorola has increased its capital expenditure plans this year to \$4.5 billion compared to \$3.3 billion last year, forecasting chip market growth between 17 and 21 per cent this year.

If forecasts turn out to be correct, 1995 will be an unprecedented third year in a row for 20 per cent plus growth in the semiconductor industry. In 1993 the industry grew 31 per cent, says Dataquest, and last year it grew 28 per cent.

Texas Instruments believes the European Market will grow 23 per cent, the US market 22 per cent and the Japanese market 17 per cent. But the star of the show will be non-Japanese Asia ("Asia Pac") with growth of 32 per cent. (Source: *Electronics Weekly*, 8 March 1995)

MMIC sales grow 50 per cent annually

The microwave solid-state electronic division of the US Electronic Industries Association (EIA) predicts the microwave monolithic integrated circuit (MMIC) market will grow by a factor of 10, to almost \$2 billion by the year 2000. World-wide communications and information links, wireless personal communications, military smart sensor defence systems, and smart vehicle highway systems will drive the market. Venture Development Corporation estimates that cellular and cordless telephone sets, specifically, will remain the two largest mobile wireless markets for MMICs. It may be expected that combined MMIC shipments of both markets will top \$500 million by the year 2000, with each category accounting for roughly half of total sales. Meanwhile, chip technology advances will push the corresponding equipment market to over \$50 billion world-wide. (Reprinted with permission from *Semiconductor International Magazine*, January 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA)

Japan powers back to top

Japanese companies have made a strong comeback at the top of the world's league table of chip production equipment makers, according to analyst VLSI Research.

In 1994, all but four Japanese firms had dropped out of VLSI's top ten. This year there are six Japanese firms in the top ten while the US is down to four firms.

Hitachi made the most dramatic improvement in its position, coming into the top ten for the first time at number seven.

US firm Applied Materials heads the league with sales of \$1.8 billion followed by Tokyo Electron (\$1.4 billion) and Nikon (\$1.3 billion). (Source: *Electronics Weekly*, 22 February 1995)

Connectors turn in best growth for eight years

The world-wide connector market has enjoyed its best growth for eight years, expanding 8 per cent to \$16.78 billion last year according to the Bishop report, which tracks the connector market.

Europe emerged from two years of recession to record a 5 per cent growth to \$4.38 billion against \$4.15 billion in 1993, although its share of the total connector market decreased from 27.6 per cent to 26.1 per cent.

The US enjoyed the biggest growth, 11.2 per cent, reaching \$6.36 billion in 1994.

The Pacific Rim grew 9.1 per cent to \$1.54 billion, while Japan grew 4.5 per cent to \$3.58 billion. The rest of the world grew 11 per cent to \$908 million.

Fastest growing product sectors world-wide were fibre optics (12.1 per cent) and PCB connectors (10.2 per cent).

Bishop forecasts a 5.6 per cent growth in Europe this year. (Source: *Electronics Weekly*, 22 February 1995)

Flat panel prices drop as market explodes

According to the *Nihon Keizai Shimbun*, Japan's equivalent of the *Financial Times*, prices of active matrix thin-film transistor colour LCDs which are 9.4 inches on the diagonal - the type used in laptop computers - have

dropped 30 per cent in the last six months - to sub-\$1,000 levels - and could go lower. And, as many predicted they would, they are dropping just as the first serious foreign competitors get their production lines under way in earnest.

This year will be the first that anyone except a Japanese company has taken a look at the business and, even so, non-Japanese vendors are not expected to take much more than about a twelfth of the 1 million unit market, according to Merrill Lynch, Japan.

The market appears to be growing like a weed. Last year, Merrill Lynch estimated it was not much more than a half million unit affair, next year it expects it to hit 1.5 million units; in 1997 - 2 million.

Adding to the soaring capacity of the Japanese, the Dutch and the Koreans are beginning to produce.

Philips began its ramp of colour low-cost, 10.4-inch panels this month, gambling on a simplified production technology called Thin Film Diode plus Reset (TFD+R), which uses only 3/4 masks instead of the 7/9 masks used by TFT producers.

In Korea, Samsung is just about to swing into mass production. They have been making large colour flat panels for over a year off a prototype line running a few hundred panels a month of both 9.4 and 10.4-inch panels. The Samsung design uses seven masks but the company hopes to get that down to six.

The production line, according to the manager of Samsung's LCD business development, has yields above the 50-60 per cent level where commercial production becomes feasible.

A consequence is that Japan's overwhelming market share will now begin to slip, but that does not detract from the Japanese achievement in being for a few years the only nation capable of mass manufacturing a key component required by a major industry. (Extracted from *Electronics Weekly*, 29 March 1995)

Semiconductor growth in Asia and the Pacific

Asia's semiconductor market outpaced other regional markets last year, according to Dataquest, with Japan's domestic market back to a reasonable growth rate (21 per cent) after a three-year dearth, and the markets in the rest of Asia exploding at 39 per cent.

Although Japan's 21-per-cent market growth lagged behind both the European market growth of nearly 30 per cent, and the overall world market growth of 28 per cent, 1994 was the first year since 1991 in which the Japanese market recorded double digit growth.

The reason normally given for the Japanese slump of the early 1990s was the collapse of Japan's domestic market for consumer goods. That may not have recovered, but the sudden rise in Japan's chip market last year came from demand for microcontrollers used in pocket phones and for DRAMs used in PCs. That demand, combined with stable prices due to supply constraints, explains the return to reasonable growth rates in Japan.

It looks as if the Japanese market is going through a character change as it puts its consumer equipment production offshore and goes for higher margin equipment businesses.

Chip companies doing best in the Japanese market last year were those from non-Japanese Asia, which achieved 108 per cent growth.

European companies grew in Japan by 36 per cent, but from an almost non-existent base; American companies

grew 23 per cent and last, surprisingly, came the Japanese companies with only 19 per cent growth in their own domestic markets.

In non-Japanese Asia, the 39-per-cent market growth was attributed to its home-grown world-class computer industry, to the moves into the region by the Japanese consumer industry going offshore, and the emergence of communications equipment manufacturing.

Malaysia and China led the growth, with India, Indonesia, the Philippines and Thailand regarded by Dataquest as "high potential" markets. (Extracted from *Electronics Weekly*, 18 January 1995)

Printed circuit boards

After a period of nearly a decade of stable laminate prices, printed circuit board makers are faced with a price increase of the order of 10 and 15 per cent, in some cases even more. Reaction from the board makers has been bitter.

In a business that has always suffered from tight margins, this latest price increase could force some board makers out of business. Others have been considering their options, none of them particularly palatable.

The profitability of a particular board depends upon a number of factors, such as the complexity of the board, the market served, and the way in which a board manufacturer operates to add value, for example whether it buys supplies locally or from the Far East.

In the case of a manufacturer of single-side boards, where the cost of the laminate may constitute 60 per cent of the overall cost of the material, the price paid for laminate will have a significant impact on the cost of the finished board.

Reaction varies according to the size of the board manufacturer. The larger ones feel a little more secure in their business, and are more prepared to put prices up. But most are not very sympathetic. (Extracted from *Electronics Weekly*, 18 January 1995)

The US information industry in 1998

A US national information policy is now emerging. The next three years will see further steps towards implementing the national information infrastructure (NII). The environment will change as commercial services providers and federal database operations find themselves in competition with each other. The elaboration of harmonization and open architecture policies by the European Union will represent a further, short-term, complicating factor in the development of a world information market.

The question will remain of which intellectual property rules are to prevail both nationally and internationally. The US Copyright Reform Act of 1993 is continuing to evolve, and the US Commissioner of Patents and Trademarks has been looking at the concept of fair use in the context of electronic copying.

The Internet has somehow to adapt to commercial operations without the old ethos being destroyed entirely. Various issues relating to copyright arise out of its continuing development, but attitudes to these will depend on whether the viewpoint is that of the information provider or the user. Another issue of continuing importance will be that of pricing: the trend towards flat-rate, subscription-based charging for on-line services is expected to continue, although some specialist databases may continue to be charged for on other bases.

Other general issues will include those arising out of consolidation or changes in ownership of resources, as well as content, media options, and delivery methods. (Source: *NFAIS Newsletter*, 36(12) December 1994)

Chip industry will double by 1999, says SIA

Semiconductors will become a \$100 billion industry for the first time this year and will double to \$200 billion by the turn of the century, according to the Semiconductor Industry Association (SIA). The industry grew 58 per cent in the last two years.

Double digit growth for the industry will continue, helped by the digital signal processing revolution which is "just beginning". Growth, however, will slow to 15 per cent annually during the remainder of this decade, and will reflect less volatility than in the past, it was predicted.

The two growth engines for semiconductors have been MOS microprocessors and CMOS memory. Three new areas are now taking off: field programmable chips, mixed signal devices and digital signal processors.

Japan's impact has been diminished by its higher cost of capital. Earlier, the lower cost of capital in Japan enabled chip makers there to gain market share. Now Japan's capital cost is at a parity with the USA, it was claimed. (Reprinted with permission from *Semiconductor International Magazine*, December 1994. Copyright 1994 by Cahners Publishing Co., Des Plaines, IL, USA)

Company News

Philips unveils CD plans

Dutch electronic giant Philips has unveiled a grand strategy for the compact disc, including rewritable and high-density versions, designed to take the 13-year-old CD into the twenty-first century.

Philips plans to launch the CD-RAM, a rewritable equivalent to the CD-ROM, by the end of 1996, with a high-density version that can store 3.7 Gbytes to follow in 1997/1998. High-density read-only CDs, for both consumer electronics and computer applications, will also appear next year, including versions that use an advanced double-layer technology developed with US firm 3M.

Philips revealed its CD roadmap as part of its bid with Sony to set the standard for tomorrow's high-quality video-on-CD format, the Digital Video Disc (DVD).

In an attempt to counter claims by Toshiba that its rival two-sided DVD format has a greater capacity, Philips and Sony have pulled forward plans to include two-layer technology in their DVD contender, the High-Density Compact Disc (HDCD).

The rewritable discs will use a phase-change technique based on materials developed by Ricoh of Japan. Existing CD-ROM drives need only a minor modification to be able to read the standard-density rewritable discs.

Philips expects the computer industry to be the fastest adopter of both rewritable and high-density CDs. Computer makers Compaq, IBM, Apple and Hewlett-Packard and software giant Microsoft have teamed up with Philips and Sony to extend the CD-ROM file structure to handle high-density and rewritable discs.

By 1998 Philips expects to have a rewritable high-density CD, although not a two-layer version. (Source: *Electronics Weekly*, 22 March 1995)

NTL picks digital TV partners

NTL, the British broadcast and telecommunications company, is rounding up a group of UK and other European manufacturers to put together a digital terrestrial television (DTT) system that may be sold world-wide.

As NTL announced its plans to set up the first UK DTT network in February 1995, it also began talks with broadcast and telecommunications equipment manufacturers, including GEC-Marconi, which manufactures transmitters.

GEC-Marconi is making the compression equipment, but not all of the other specialist equipment. The equipment will meet the European digital TV standards set by the Digital Video Broadcast (DVB) grouping last year. NTL is aiming at what is expected to be a huge market to upgrade the world's existing analogue TV infrastructure to digital technology. The installation of the UK's DTT network alone represents a multi-million pound market for the electronics industry.

Talks between NTL and potential consortium members will continue over the next few months, while the Government considers drawing up legislation to enable the introduction of a terrestrial digital TV service in the UK. (Source: *Electronics Weekly*, 8 March 1995)

Optical network project

Monet, the US optical network consortium, has announced a five-year \$100-million project examining the techniques of wavelength division multiplexing, which allows additional data to be sent along an optical fibre by using several different colours of light simultaneously. \$5.4 million of the total will come from the Advanced Research Projects Agency, which is part of the US Department of Defense. Monet is a consortium of AT&T, Bell Atlantic, Bellcore, Bell South and Pacific Telesis. (Source: *Electronics Weekly*, 1 March 1995)

Thumbs down for Internet

US households show little enthusiasm for interactive electronic technologies, according to the latest research.

A study involving more than 7,500 households found interactive TV services such as video on demand, cruising the Internet and electronic home shopping services low on the list of technologies people want.

Respondents said they preferred to rent videos at a local store rather than pay for the convenience of ordering movies directly through a set-top TV box.

Only six per cent said they use the Internet and only about 38 per cent were interested in using it.

Those surveyed displayed much more enthusiasm for current technologies such as direct broadcast satellite TV systems, big screen TVs, CD-ROM drives and camcorders. (Source: *Electronics Weekly*, 29 March 1995)

Motorola to develop new smart card core

Motorola is developing a brand new chip architecture for its future smart card microcontroller products.

The development is part of a revamping of the company's growing smart card IC business, which includes setting up the world-wide headquarters for the business at Motorola's expanding site in East Kilbride, Scotland.

Motorola's current range of smart card microcontrollers, which runs to 200 customized versions, are based on the 8-bit HC05 microcontroller core. The group's Scottish development team is looking at a number of options for the

new smart card architecture including a customized DSP core and a low-power Risc processor.

Motorola wants to increase the processing power of its smart card chips in order to support the new generation of public key encryption algorithms which will be needed for the bank card market being created by projects such as Mondex and Visa/Mastercard.

Motorola's decision to base its smart card business in Scotland is a recognition of the strength of the European smart card market. A company spokesman predicts that Europe will account for half the world market, or 1 billion to 2 billion cards by the year 2000. (Source: *Electronics Weekly*, 8 February 1995)

Record results for chip makers

Continuing growth of the world's electronics market has helped to generate record results at a number of US chip makers.

Programmable logic specialist Altera reported a 42 per cent increase in sales to \$198.8 million for the year ended 31 December. A 45 per cent increase in operating profit in the fourth quarter to \$10.4 million was completely absorbed by a \$24 million charge resulting from the acquisition of Intel's PLD division in October. The purchase price of the Intel business was \$38 million.

Cyrix, the Texan X86 clone maker, almost doubled sales last year to \$246 million. Sales in the fourth quarter were 123 per cent up at \$73 million. Cyrix quadrupled sales of its 486DX2/66 microprocessors and in January began volume production of the 486DX2/80 chip. The company also expected to start sampling its next generation M1 microprocessor in February.

Atmel reported a 58 per cent increase in fourth quarter sales to \$108 million, and sales for the year were 69 per cent up at \$375 million.

IDT reported a 24 per cent increase in sales in the third quarter at \$106 million and a 70 per cent increase in profit at \$20 million. Prices of its 3.3 V and 5 V SRAMs increased. (Source: *Electronics Weekly*, 25 January 1995)

Intel increases flash density

The first fruits of Intel's research on storing more than one bit per transistor could appear in 1996 in new higher-density versions of Intel's flash memories.

Intel says it will sell higher-density devices which take advantage of both the new "multi-level cell" technology and also improvements in the company's process technology.

Intel is also in the planning stage of a billion dollar wafer fab solely to make flash which, says Intel, should be built in the next three years. (Source: *Electronics Weekly*, 8 February 1995)

High powered X-ray lithography collaboration

Engineers at IBM's Microelectronics' Advanced Mask Facility (Burlington, VT) and Advanced Lithography Facility (Hopewell Junction, NY), IBM's T.J. Watson Research Center (Yorktown Heights, NY), Loral Federal System's VLSI Facility (Manassas, VA), AT&T Bell Laboratories (Murray Hill, NJ) and Motorola (Phoenix, AZ) will begin working together in the newly-formed Proximity X-ray Lithography Collaborative Association. The objective is to explore the use of X-ray lithography for future semiconductor manufacturing applications. The four principal companies formed the association to share technology, reduce

development costs and to encourage acceptance of the technology.

IBM and AT&T have more than 20 years of experience in X-ray lithography. At its East Fishkill facility, IBM operates the Western Hemisphere's only commercial synchrotron, which is specifically used as an X-ray source for lithography. AT&T has the only commercial point-source X-ray stepper for advanced lithography. Loral has one of the preeminent space-qualified radiation-hardened foundries in the United States, and Motorola has been actively exploring X-ray lithography for four years using synchrotron sources at the University of Wisconsin and at IBM.

Funding for the association will come from the four companies and Advanced Research Project Agency government contracts. In addition, other semiconductor manufacturers, universities and government laboratories are expected to join. (Reprinted with permission from *Semiconductor International Magazine*, December 1994. Copyright 1994 by Cahners Publishing Co., Des Plaines, IL, USA)

Hitachi, VLSI develop 0.35-micron Asic process

Hitachi and VLSI Technology have developed a 0.35-micron Asic process that they claim will be the industry's densest, offering up to 5 million usable gates. The process has a 2.2 to 3.6 V supply range and up to five metal layers with a track pitch of 1.4 microns. VLSI says it will translate all its existing library elements to the new process this year, ready for production in the second quarter of 1996. (Source: *Electronics Weekly*, 19 April 1995)

Matsushita move hots up high-density CD battle

The battle to set the standard for tomorrow's high-density compact discs was thrown into confusion after Matsushita announced it had developed a double-layer disc.

Matsushita is backing Toshiba's "SD" double-sided, single-layer disc technology, against the rival double-layer system proposed by Philips and Sony. By announcing a double-layer variant of the Toshiba disc, Matsushita has raised speculation that a compromise combining elements of both formats could still be on the cards.

Like the single-layer "SD" disc, the new Matsushita disc is formed from two platters stuck together. Like the double-sided version, the double-layer "SD" disc can store 9 Gbytes, compared to 7.4 Gbytes on the Philips/Sony double-layer disc. (Source: *Electronics Weekly*, 26 April 1995)

Service for year date processing of programs

Case Technology Co., Ltd., a developer of software, has started offering a service for processing existing programs into year dates beyond the year 2000, as the information processing systems of virtually all enterprises are incompatible with the years beyond 2000.

Most programs display the years with two-digit figures, indicating the year 2000 as "00", so when computing financial and sales data, these programs will eventually become confused. Therefore, computer companies are striving to resolve this "year 2000 display issue".

The system of displaying years with two digits indicates the year 2000 as "00" and the year 1994 as "94", so there is a possible error that the year 2000 precedes 1994, making it impossible to calculate the terms for computing interest on loaned capital. Most main frame systems developed before the 1980s display the years only with two-digit figures for memory saving and for improving the processing efficiency.

Large-scale system users such as financial organizations have devised methods for switching over to display in four-digit figures, but virtually all medium-scale users have taken no steps for improvement due to system renewal and the existing recession.

The most cumbersome part in the processing of year dates is the identification of the parts to be processed from the voluminous program. The company uses its maintenance support system (computer-aided software engineering (CASE) tool), or Reverse Engineering System for Comfortable User's Environment (RESCUE), to automatically analyse what parts of the old program are related to the year dates, converts these parts into four-digit figures, then confirms whether the system operates satisfactorily subsequent to the conversion.

RESCUE is a special-purpose maintenance software that automatically assesses what parts are related when a program is used and discovers the parts to be revised.

The company is presently engaged in research to incorporate RESCUE with the function of automatic revision into four-digit display with the schedule of completion in the early half of 1995 and to commence services from the latter half of the year. The service performs year corrections and enables total maintenance of entire information processing systems.

Further details available from: Case Technology Co., Ltd., Marketing and Sales Division, Iidabashi Building, 2-7-18, Fujimi, Chiyoda-ku, Tokyo 102; Tel.: +81-3-3234-9271, Fax: +81-3-3288-0146. (Source: *JETRO*, February 1995)

E. APPLICATIONS

Cats-eye to save lives

An innovation from Doncaster-based R&D firm Astucia is claimed could save the European Union over £2 billion and more than 2,500 lives per year.

The invention is a light-emitting cats-eye, named Intelligent Road Stud (IRS), that can warn drivers of impending dangers on the road.

The IRS circuit consists of a couple of microcontrollers, a solar cell and an array of sensors powered by daylight, car headlights or a battery.

Depending on the danger the IRS will emit red, blue, orange or white light respectively. (Source: *Electronics Weekly*, 26 April 1995)

Micron Technology backs burst EDO DRAM

Burst EDO DRAM, a potential low-cost alternative to synchronous DRAM, has gained significant new support as US memory maker Micron Technology prepares to ship samples in the third quarter this year.

The announcement comes as the technical specification for burst EDO DRAM is reaching the final stages of Jeduc approval. This could further tighten the hold by EDO DRAM on high performance memory applications, restricting synchronous DRAM to niche applications.

PC motherboard makers Matsushita and Micronics and DRAM manufacturers Oki and Samsung have joined the list of DRAM chip and module suppliers and PC chipset firms that plan to support EDO DRAM. A total of 10 PC chipset suppliers now intend to support the format including OPTi and VLSI Technology.

PC makers are particularly keen on using EDO DRAM because it requires no motherboard layout changes, unlike synchronous DRAM, needing only a small timing change in the memory controller. (Source: *Electronics Weekly*, 26 April 1995)

Crime will pay for automotive firms

The expectations of electronics suppliers and motor manufacturers have been growing due to plans to amend the EC Anti-Theft Directive (74/61/EEC). The amended directive states that as of January 1997 all new car models have to have immobilizers and alarms fitted, and from October 1998 this will apply to all vehicles sold.

Security systems require electronics and manufacturers are anticipating a potential half billion dollar automotive electronics market, and a flood of new electronic vehicle security systems is expected to appear very soon.

According to the industry analyst BIS Strategic Decision, the 1998 market could be worth in excess of \$400 million of electronics alone.

In London alone, more than half of stolen vehicles are not recovered. But increasingly car crime deterrents have been relying on electronics and the latest technological advances.

BIS estimates that currently around 25 per cent of European car production includes factory-fitted alarms and immobilizers. Most security devices, if not available with the car when newly bought, are retro-fitted. The VSIB (Vehicle Security Installation Board) figures show that in 1993 there were around 200,000 installations of alarms and

immobilizers. Projections have it that this figure will double in 1995 alone.

The aftermarket fitment services are likely to continue growing, especially with the arrival of newer, more effective systems. There is already talk of specialist aftermarket immobilizers which may be combined with other security devices such as tracking systems and hidden miniature in-car cameras, which will film the thief at work.

But it is the motor manufacturers which the police, insurance companies and other interested parties are relying upon to design in high-integrity security systems and as early as at the concept stage of a new vehicle.

However, car companies are concerned over the problems created by the growing number of legal security requirements. Ford states that there are over six different legal and insurance requirements that need to be fulfilled before even starting on a new design of a security device to fit in a new car model. This is aggravated by a lack of a common standard for vehicle security devices, a standard test and the differences in requirements from different countries.

And although the inconsistencies between some of the requirements proved time-consuming and expensive, motor manufacturers now fear they will be asked to do more.

There are a few levels of security for cars: perimeter security, immobilizers, accessory security, special markings and vehicle location and recovery. Perimeter security consists of good door, bonnet and boot locking, and sunroof glazing and fuel cap security. Based on electronic systems, such as remote control access, it will help to reduce the visibility of the locks themselves.

Immobilizers can be of a mechanical, electro-mechanical or electronic nature. But by far the most popular immobilizers appear to be the ones based on electronics.

The most widespread design is the passive transponder system used in conjunction with an ignition key. The system is operated through a rolling code radio transmitting key fob. Both interact with the engine management system and will frustrate any thief who attempts to hot-wire the vehicle.

Special markings entail vehicle identification numbers (VINs) that can be stored within electronic units or modules within the vehicle. These can be smart cards or RF-ID tags that can be fitted in some hidden location on the vehicle.

As for vehicle location and recovery systems, many new devices are appearing on the market although they have not been identified by the amended EC directive as compulsory for new car models. A couple of systems are already available on the market and are used by the police.

The idea of having tracking devices within a car has been taken further. It is expected that vehicle tracking devices will be combined with satellite-based GPS navigation aids and radio data networks. The cost of these systems will be spread by incorporating car diagnostics and engine monitoring.

The added advantage is that when the car is stolen, the tracking police car can slow it down by controlling the management system over the radio link. But such a system will raise a new set of engine tampering and safety concerns which should keep the regulators busy for

some years yet. (Source: *Electronics Weekly*, 19 April 1995)

Video over telephone lines is a commercial reality

Video compression and transmission technology must be available on a single chip costing less than \$90 for video over telephone lines to become a commercial reality, according to Motorola.

The company also believes it now has the technology to achieve this with the licensing of the discrete multi-tone (DMT) modulation scheme developed by Amarti Communications.

Amarti's DMT analogue line modulation scheme will be incorporated into a single chip transceiver for the asymmetrical digital subscriber line (ADSL) systems which operators like BT plan to use to deploy video-on-demand services over existing analogue telephone lines.

Current ADSL systems, including those being evaluated by BT, support one-way video transmission to the subscriber using a 2 Mbit/s digital channel. Amarti claims that its DMT-based technology will support a 6 Mbit/s channel to the subscriber and a 640 Kbit/s return channel to the exchange. As well as supporting multiple TV channel transmission, an integrated DMT transceiver could reduce the cost of ADSL hardware. Motorola, which plans to market its first DMT chips in 1996, has set a target price for the silicon of under \$90. (Extracted from: *Electronics Weekly*, 19 April 1995)

ARPA funds "blue" laser

The US Advanced Research Projects Agency is funding the development of blue-light laser diodes, based on gallium nitride materials on silicon carbide wafers, by Philips subsidiary, Philips Laboratories and Cree Research.

One focus of the project will be to develop higher capacity optical data storage devices.

Other firms are also trying to find ways to build blue-laser diodes cheaply. Advanced Technology Materials is working with Hewlett-Packard to develop blue laser diodes, also using gallium nitride. Japanese firm Nichia Chemical Industries says it is already sampling blue-laser diodes for about \$30. (Source: *Electronics Weekly*, 19 April 1995)

Smart cards

The development of applications from highly secure bank cards to throw-away phone cards is expected to open opportunities for semiconductor suppliers in the second half of the decade.

According to market research analyst Dataquest, the smart card market will have a compound annual growth rate (CAGR) of 30 per cent until 1998. Dataquest values the demand for silicon at £1.3 billion in Europe alone. But for chip suppliers smart cards represent not one but many markets of varying importance and requiring products of different complexity. There has been a natural division of this industry into four main areas according to application; these are the electronic payment, physical access control, logical access control and portable files. Electronic payment includes banking, finance, road tolling and public transport applications. Into logical access control fall pay-TV and mobile phones and into physical access control safety and security areas. The portable files group covers health, personal and security information services.

The major smart card semiconductor manufacturers are SGS-Thomson, Motorola, Hitachi and Siemens. Motorola has 27 per cent market share and SGS-Thomson and Siemens have 26 per cent each.

Perhaps the most important finance smart card project is that being developed by credit card giants Visa and Mastercard. Visa is working with European smart card makers Schlumberger and Gemplus and the first prototype cards should be delivered later this year. Orga, another European manufacturer, is Mastercard's partner in the Europay Masters Visa (EMV) initiative.

Like many card makers, Orga sees its largest market in electronic SIM cards for personalizing GSM mobile phones. It is expected that by the year 2000 GSM SIM card revenues will expand to more than \$200 million. (Extracted from *Electronics Weekly*, 8 February 1995)

Taking a swipe at the terminal

It did not take long for somebody to think of a smart card that can work without any physical contact with a terminal. And now vendors are designing and developing contactless smart cards.

Based on RF communications, the contactless card eliminates the need to put the card in any sort of reader. Therefore its prime applications appear to be in transportation, ticketing, access control and labelling.

Economically, contactless transactions can be up to 25 per cent cheaper due to their non-stop usage, faster queue movements and reduced personnel to manage entries. But the card needs a radio transmitter, antenna and, depending on its complexity of use, a microcontroller and/or some memory where information can be stored. Processing speed is important in contactless applications like public transport and road tolling because the use of a radio interface means that the card's transaction time must be as short as possible.

Most of the existing contactless cards work more or less on the same principle. The card has no battery of its own so it is powered inductively by a magnetic field emitted by the card reader.

Although contactless cards have started receiving attention from many companies, there is the issue of standardization. Currently there are no standards. This means that most suppliers have opted for proprietary designs, such as the card size, and the frequencies and data rates used. (Extracted from *Electronics Weekly*, 8 February 1995)

Vital Asic libraries appear

The first long-awaited Vital compliant VHDL Asic libraries are beginning to appear - nine months after the Vital working group established a workable technical specification.

Fujitsu Microelectronics in Europe and Texas Instruments in the USA have both released Vital model libraries for gate array technologies. The Fujitsu libraries, supporting 0.65 μm and 0.5 μm CMOS gate arrays and embedded cell arrays, were a European initiative driven by its engineering group in Frankfurt.

The Vital specification defines a standard form for a VHDL Asic model including mechanisms for passing functional and timing information to a simulator. The specification is going through its IEEE standardization procedures where it has been modified. (Extracted from *Electronics Weekly*, 8 February 1995)

VVL betters its camera on chip

VLSI Vision, the Edinburgh-based camera-on-a-chip company, is developing new products that overcome a significant problem of its first-generation sensors.

The new VVL devices, due shortly, are to have a much improved "pattern noise" performance. Pattern noise is degradation in the image produced by the camera caused by process-related circuit variations. These variations alter the intensity of both individual pixels and whole columns causing speckles and highly noticeable "stripes" in the image.

The improved VVL sensors will have resolutions of about 312 x 287 and 768 x 574 pixels.

Unfortunately, the architecture of the VVL sensors means they are particularly susceptible to pattern noise. The photosensitive array in the VVL camera exploits a well-known technique: if a photodiode is added to an ordinary DRAM cell in parallel with the cell's capacitor incident light it will generate a current partially discharging the junction capacitances. The photodiode is formed by extending the drain region of the access (or pass) transistor. Analogue sense amplifiers at the top of every bit line sense and amplify the charge on each pixel in the column. It is the process related variations, or offsets, in the threshold voltages of the amplifiers that cause the pattern noise (seen as stripes). Also, since the charge from individual pixels has to drive down a bit line to reach the amplifier local pixel variations can give individual pixels differing intensities.

However, in the US, engineers from AT&T Bell Labs and NASA's Jet Propulsion Lab have opted to add a source follower amplifier to each individual pixel on their array. The penalty is an increased pixel size but the array suffers from less pattern noise and can be accessed faster. The team has demonstrated a 256 x 256 pixel sensor, and AT&T engineers are following on with a 1024 x 1024 pixel sensor.

The 256 x 256 pixel sensor was built in a 0.9 μm CMOS process and each pixel measured 20 x 20 μm^2 with 25 per cent of the area actually taken up by the photogate (called the fill factor). The 1024 x 1024 sensor is currently being fabricated by AT&T in a 0.5 μm CMOS process.

The pattern noise of the initial sensor was 1 to 2 per cent of saturation. But a noise cancellation circuit, which has already been demonstrated on a JPL-manufactured camera and will be incorporated onto the larger AT&T camera, reduces that figure by an order of magnitude. (Extracted from *Electronics Weekly*, 22 March 1995)

Vertical MCM is complete camera and imaging system

Engineers from the University of Sheffield have developed an integrated camera and image processing system built using 3D MCM technology.

The system uses standard components but was devised to exploit the integration potential of MCM-V (vertical MCM) technology developed by Thomson CSF.

The image is captured in a 312 x 287 pixel sensor, digitized to 8 bits, reformatted and compressed using motion-JPEG at 3 frames/s. Nine chips and 40 discrettes are integrated into 4769 mm^3 , six times denser than a PCB implementation.

Processing is carried out using four Inmos transputers in a pipeline. The first supervises data reads from a FIFO (which acts as a data rate buffer) and transfers the data across its serial links. The image resolution is reduced by

vertical and horizontal decimation to produce QCIF images of 176 x 144 pixels.

The second transputer is linked to two 32 K x 8 SRAMs which act as image store. The other two transputers are for general processing operations. In the implementation of JPEG, for example, they would perform the DCT quantization, zero-run length packing and Huffman encoding. The system can be reprogrammed via the transputer serial links.

The demonstration board contains the MCM under a quartz window. It is surrounded by heatsinks to allow its operation in still air. However, Jon Stern, co-author of the only paper at the ISSCC to originate from the UK, says the heatsinks are excessively large, because of over-caution, and the module dissipates only 2.5 W. The heatsinks are likely to be smaller and become an integral part of the product. (Source: *Electronics Weekly*, 15 February 1995)

Electronics gets motor going

Electronics are the key to a new kind of cheaper, smaller, electric motor for commercial applications like washing machines, vacuum cleaners and electric hand drills. A university research project sponsored by industry was set up 18 months ago to find out if control electronics could be made cheaply enough to bring this elegant design out of the laboratory and into the real world. This project is under the joint leadership of Professor Hugh Bolton at Cardiff University and Dr. Charles Pollock of the University of Warwick.

Invented around 1840, the switched reluctance (SR) motor was the first, and is conceptually the simplest, type of electric motor to be invented. Practical exploitation has had to wait until semiconductors have been developed to make it work.

The motor works in the same way that an electromagnet attracts a piece of steel. Like all rotary motors, the SR motor has a rotor and a stator. The rotor is a steel cylinder with ridges outside running along its length. This fits inside the stator which is a hollow steel cylinder with ridges running along its inside. Long narrow coils of wire are fitted over the ridges of the stator, turning them into electromagnets. Imagine a stator with three coils and a rotor with one ridge. When current is applied to one of the coils the rotor will swing around until the ridge aligns with the energized coil. The rotor is then rotated by sequentially operating the coils. This is a simple three "phase" motor. Practical versions have more coils but the principles are the same.

The mechanics of the motor are simple. Both parts are quick and cheap to construct. To retain the cost advantage brought by the mechanical parts and ease of construction the electronics must be cheap.

The electronics have two functions: to switch the current in the coils and to control the moment of switching.

Essentially the motor requires one power transistor switch per phase. This is immediately an advantage over the brushless DC motor (another contender for the "simplest motor" crown) which needs bidirectional current in its windings and so requires two switches per phase. The Cardiff-Warwick team have designed motors with fewer phases to further cut the number of power semiconductors required.

The timing of the switches is controlled by the rotor position. This position is sensed either optically or magnetically. Professor Bolton's group use optical pick-ups

for electrical simplicity but the final product may use these. Hall effect or inductive sensors.

The presence of the sensors and power switches provides opportunities to add other features. Active power factor correction to make the motor compatible with on-coming EC directives is one. Sound level reduction is another. This type of motor is prone to acoustically ring as current in the coils is turned off. By turning them off in two stages, the university group introduce two anti-phase vibrations which cancel each other out.

There is an electric door slider based on the same principle and some large industrial machines. Development by several teams continues world-wide. The prize for the "right answer" is the huge market for maintenance-free low-cost motors in domestic appliances, power tools and cars. This technology is one of the leading contenders for that prize. (Source: *Electronics Weekly*, 5 April 1995)

Altera sneak previews PLDs

Altera has revealed further details of its FLEX10000 family of CPLDs, due to make its debut towards the end of this year with 50,000 and 100,000 equivalent gate devices.

The architecture of the FLEX10000 adds configurable blocks of memory to a hierarchical routing scheme first seen on the FLEX8000 family. The device contains a 2-D array of logic array blocks each containing eight logic elements. Each element comprises a 4-input look-up table, cascade and carry chains, a register and muxes.

An individual element can perform any logic function of four inputs and elements can be cascaded to form more complex logic functions. Local interconnection delay is limited to 1ns. The internal buses can be tristated to allow internal functions to communicate across a single bus.

Logic array blocks are interconnected via a 2-D matrix of wiring channels which run across the chip. Connecting blocks using row interconnect only takes 6ns with another 3ns needed if column interconnect is required. These delays are fixed giving predictable routing.

An embedded array block is sited at the end of each row and contains 2 kbits of SRAM. The SRAM can be used to implement large functions such as multipliers, filters and micro cores in the form of look-up tables.

Specialized addressing modes and I/O signals allow a flexible width and depth organization, synchronous or asynchronous operation and permit the blocks to be cascaded.

Samples of the chip are due in the third quarter of this year. (Source: *Electronics Weekly*, 22 March 1995)

VLSI demodulator based on HDTV trial system

A single chip digital TV demodulator based on the 64/256 QAM systems used in North America's Grand Alliance HDTV trials has been introduced by VLSI Technology. The quadrature amplitude modulation (QAM) system, which could also be the basis of European terrestrial digital TV transmissions, was developed by Californian developer Applied Signal Technology and integrated by VLSI Technology into its library of functional system blocks.

The quadrature downconverter equalizer demodulator (QED) would be used in QAM cable TV set-top box receivers. It sits between the cable and the MPEG compression functions and extracts the digital video and audio data streams from the 64/256 QAM modulated signal on the cable TV network.

Operating at a 43.75 MHz IF, it supports symbol rates up to 5.4 MBaud and implements the Reed-Solomon forward error correction algorithm.

The QAM protocol combines traditional amplitude modulation and quadrature phase shift keying (QPSK) to put the digitally coded TV signal on the carrier frequency.

The QAM device is one of a number of chips VLSI is offering for low-cost set-top box receiver designs. It is developing a separate QPSK demodulator with ComAtlas of France, and an MPEG-2 codec with US specialist Mediamatics. (Source: *Electronics Weekly*, 22 March 1995)

System for reduction of power consumption

KEC Inc. has developed a system that enables power consumption to be suppressed considerably when the system is fitted onto electrical equipment such as facsimile systems which are connected to the telephone. The system is normally in the switched off state, but is switched on whenever it senses a telephone call, and the power is cut off automatically whenever the telephone call is terminated.

The new product, called the SOD device, is a system that switches the power unit on or off automatically only when required by the queued power consumption type information processing equipment connected to a communications circuit. The power unit wiring and telephone signal line are connected to electrical equipment such as a facsimile system via the SOD device. Whenever a telephone call is made, the current flowing through the telephone line is converted into a voltage. This change is sensed by the SOD system semiconductor sensor and the power of the electrical equipment such as a facsimile system is switched on. When the call is terminated, the end of the telephone link is sensed and the power is switched off automatically.

The voltage change in the telephone circuit generated by lifting and replacing the receiver turns the switch on and off, so the SOD system does not consume any power. Therefore, when transmitting or receiving facsimile messages for 15 min/day using a facsimile system with a queued power consumption of 12 W, it will be possible to conserve more than 100 kWh of electricity per year.

The system is usable with facsimile systems and other equipment linked with the telephone, or for personal computer communications computers and systems for selecting telephone companies with the lowest service charges. In personal computer communications, the system is selected by considering the time necessary for the computer power up. By using the system in combination with software for automatically transferring mail messages and other data, it will be possible to cut off the personal computer's power in the instant the necessary communications have been completed.

The prototype system is an externally fitted type, but the company plans to develop an internally fitted type with the cooperation of facsimile system manufacturers.

Further details from: KEC Incorporation, 1998-2, Minari Minogo-cho, Onomichi City, Hiroshima Pref. Tel.: +81-848-48-3241, Fax: +81-848-48-5287. (Source: *JETRO*, February 1995)

New small polyacene battery for memory backup

Kanebo Ltd. and Seiko Instruments Inc. have jointly developed and commercialized the world's smallest 414 Type Polyacene Battery that uses a non-aqueous electrolyte and is designed to accommodate the accelerating miniaturization and performance improvement of portable equip-

ment. The heat-resisting moulded battery enables reflow soldering (integrated soldering) when mounting the battery on a printed circuit wafer.

The polyacene battery is a secondary battery using polyacenic semiconductor (PAS) developed by the company as the electrode, and features the three basic characteristics of high voltage—large capacity, low internal resistance and high reliability over a long period of time. The battery has a working temperature of -25 to 70° C and can be recharged over 10,000 times.

The commercialization of this heat-resisting moulded polyacene battery has raised the heat-resisting levels of batteries considerably. The battery casing is moulded with a special type of heat-resisting resin, so allowing the memory backup battery to be a surface mounted device (SMD). The introduction of the reflow soldering method eliminates the need for manual soldering, so the efficiency of assembling the battery into equipment is improved to enable substantial labour-saving.

The new battery is usable in portable communications equipment such as pagers and portable telephones, in electronic ledgers, and for the memory backup of small electronic equipment such as notebook-type personal computers.

Further details from: Kanebo, Ltd., 1-3-12, Moto-akasaka, Minto-ku, Tokyo, Tel.: +81-3-5411-3526, Fax: +81-3-5411-3527. (Source: *JETRO*, February 1995)

Five-loudspeaker surround effect using only two loudspeakers

Victor Co. of Japan, Ltd. (JVC) has established a technology called Dolby Pro Logic 3D-PHONIC that enables playback in a stereophonic sound effect of Dolby ProLogic Surround using only the two loudspeakers of a stereo system.

Today, video software such as the videotape and laser disc systems include the stereoscopic Dolby Surround to enable pleasant acoustic listening with a sense of concert-hall presence in amusement theatres and homes. However, playback of this Dolby ProLogic Surround requires a total of five channels of amplifiers and loudspeakers: three channels at the front left, right and centre, and two channels on the left and right sides. This makes the system installation, wiring and adjustment complicated.

The new technology is based on an improved version of the 3D-PHONIC stereophonic technology the company developed earlier which enables stereophonic sound to be localized 360 degrees around the listener. Furthermore, in the new technology, correlation decrement is processed to regenerate stereophonic sound, then the processed surround signal and the centre signal from the system are added on the left and right, with the result that a natural, dynamic surround sound is created simply with two front loudspeakers.

The introduction of this new technology enables surround sound to be generated by two front speakers from household systems and permits the construction of simple TV and AV systems for playback in a Dolby ProLogic Surround environment.

The company is presently developing a single-chip LSI incorporating the new technology and a Dolby ProLogic decoder, which will be mounted on colour TV sets for the European market, then gradually applied to other audio/video systems.

Further details from: Victor Co. of Japan, Ltd., Public Relations Office, 3-12, Moriya-cho, Kanagawa-ku, Yokohama City, Kanagawa Pref. 221; Tel.: +81-45-450-1489, Fax: +81-45-450-1498. (Source: *JETRO*, March 1995)

Special-purpose optical connector and module for short and medium distance data communications

Sumitomo Electric Industries Ltd. has developed a special-purpose optical connector and module for short and medium distance data communications which use a hard plastic-clad quartz fibre (H-PCF), and has started distributing samples of the new connector and module.

The H-PCF is used in office automation (OA) and factory automation (FA) systems and has attracted attention as a communications infrastructure for multimedia connections of optical fibre trunk lines to households.

By using the H-PCF in combination with the newly developed connector and module specifically for short and medium distance data transmission, it will be possible to retain a transmission volume comparable to that when using an all-glass fibre (AGF).

The H-PCF is primarily used as an infrastructure for short and medium distance communications up to 500 m such as the local area network (LAN) information communications systems in factories and offices. The H-PCF is expected to come into wide use commercially for digital image transmission and optical switching, as well as for communications infrastructures.

Further details from: Sumitomo Electric Industries, Ltd., Administrative Department, 4-5-33, Kitahama, Chuo-ku, Osaka City, Osaka 541; Tel.: +81-6-220-4119, Fax: +81-3-222-3380. (Source: *JETRO*, March 1995)

Tactile audio diagram for blind persons

Professors N. Ohnishi, N. Sugie, H. Minagawa and their research team of the Department of Information Engineering, School of Engineering, Nagoya University, have developed a tactile audio display system for blind persons.

The system consists of a tactile display with digitizer, a voice recorder, a voice synthesizer, a keyboard, a disk unit and a personal computer. By relying on tactile and auditory senses, the system is operated in conversational mode to read, write and store diagrams.

Sighted people use diagrams frequently to reorganize the process of thinking or to express ideas to others, because diagrams enable information to be represented in two-dimensional form and to be displayed more appropriately than words. However, the blind cannot use these diagrams. Therefore, dots and lines are imprinted on paper as a graphical representation means for the blind, for recognition with the fingers or the palms of the hands.

However, it is difficult to represent detailed information by tactile diagrams, and when braille and symbols lie in an intricate mix inside a diagram, reading becomes very difficult, and it is virtually impossible for the blind to write a tactile diagram. Therefore, there had been a need to develop a system which enables blind persons to read and write diagrams easily.

The new tactile audio display system consists of a tactile display with digitizer for outputting tactile diagrams to the user and for inputting coordinates by the blind, and uses a palm-sized pin matrix consisting of 8 x 8 pins and

measuring 160 x 150 mm, with each pin driven with a solenoid and whose height can be changed in three stages. A small switch is embedded at the top of each pin to input the position of the coordinates depressed with the fingers.

The voice recorder is used for recording voice data from a microphone into the memory of a personal computer, and the stored voice data are played back through a loudspeaker, and can also be used for transmitting messages to the user, such as the name of the input command, echo-back or input demand from the system. The user inputs commands into the system using the keyboard, and one or two keys of a personal computer are depressed simultaneously to input a command.

The storage system stores diagrammatical files which compile the input voice and diagram data, with each given a voice file name to distinguish files. The personal computer is used for controlling the overall flow of the system.

The system also incorporates a simple help function that informs the user of the state of system performance with voice messages by which the blind user can constantly control the overall system. The system has already been confirmed through tests conducted with the cooperation of a school for the blind, to enable a blind person to operate the system freely to read out information from diagrams or to represent images diagrammatically. The research team plans further research to develop applications for the system, such as use in musical and other media and for producing maps for learning walking courses with the aim of commercializing an advanced system that improves the communications capabilities of blind persons.

Further details from: Nagoya University, Department of Information Engineering, School of Engineering, Furocho, Chikusa-ku, Nagoya City, Aichi Pref. 464-01; Tel.: +81-52-789-3098, Fax: +81-52-789-3814. (Source: *JETRO*, March 1995)

F. SOFTWARE

Omron develops multilingual software for Internet use

Omron has developed software which will allow users to freely exchange information regardless of language. This software, which is targeted at use on the Internet—the world-wide information and communications network—will be available on the market in early 1995. As a first step, this single software package will be able to handle English, Japanese, Chinese, and Korean. English has become the “official language” on the Internet and this is hindering its spread into regions outside of Europe and America such as Asia. Omron has decided to participate in the World Wide Web Consortium (W3C), a group which is standardizing the Internet, and is working to have this software adopted as the global standard.

Omron has developed a language entry system designated “FI-Wnn”. This single piece of software can handle, at the same time, English, Japanese, Chinese (Mandarin and Cantonese), and Korean. For example, this software will allow companies in Japan, Europe, and America to send information, in Chinese, to customers in China. The data receiver can also analyse information in various languages. This will allow users in Japan to easily receive data from abroad, such as technical information written in other Asian scripts.

Currently, language entry methods vary by country and, therefore, most of the computers in use throughout the world are limited to processing information which exists either in their own country’s language or in English.

In the future, they plan to expand the software so that it will be able to process European languages, Thai, Vietnamese, and Hindi. (Source: *NIKKEI Sangyo Shimbun*, 17 January 1995)

Thumb trick improves ARM's code density

A rather clever electronic sleight-of-hand is at the heart of ARM’s Thumb 16-bit microprocessor variant designed to improve code density for embedded applications.

The ARM7DTMI chip, the first to use the patented techniques, increases code density by up to 30 per cent by employing a subset of the conventional 32-bit ARM instruction set that can be encoded using a 16-bit word. This means the microprocessor can use smaller and cheaper external program memory.

The Thumb architecture requires a small amount of separate circuitry—no more than 1,000 gates—that can be added to any ARM microprocessor. The Thumb instruction set contains about 36 of the simpler 32-bit ARM instructions, essentially those that can be easily reduced to a 16-bit word because a few of the fields do no work and contain zeros.

A Thumb-aware microprocessor can utilize both 16- and 32-bit instructions. However, two essential operations have to be performed on the 16-bit instruction before it can be executed in the conventional manner by the microprocessor.

First, up to 8 bits in the Thumb instruction are expanded by a PLA into 11 key bits that the conventional 32-bit instruction decoder uses to identify major operations such as a multiply. Second, the remainder of the 16-bit Thumb instruction is expanded into the conventional 32-bit

format by reordering and by adding fields that were removed.

A Thumb-aware microprocessor can swap between instruction types at sub-routine boundaries in the program. A special bit in the status register tells the microprocessor whether it is receiving conventional 32-bit or 16-bit Thumb instructions. However, a Thumb instruction has limited access to just 8 of the ARM’s 16 registers. But the architecture retains the capability to execute 8-, 16- and 32-bit data types.

Future implementations of Thumb will add a second, parallel instruction decoder removing the separate PLA step. This will mean there will be no performance penalty to using Thumb code although the code will be up to 30 per cent denser. (Because the Thumb instructions are necessarily simpler than the most complex 32-bit ARM instructions they do less work and hence the code density increase cannot be 100 per cent.) The first chip to implement the architecture will deliver 20Mips in a 16-bit system running at 33 MHz. (Source: *Electronics Weekly*, 8 March 1995)

Microsoft bids for dominance of global online and broadband services markets

Microsoft intends to attack the global online and broadband services markets using a combination of five approaches: the *Windows 95* PC operating system, *Exchange* (E-mail and networking software), the *Broadband Network Operating System* software for interactive television applications, the Microsoft Network (MSN) online service, and links with electronic financial services providers such as Visa. At the same time, through links with publishers such as Dorling Kindersley, it hopes to become a major player in the CD-ROM publishing market.

Microsoft estimates it will sell about 20 million copies of *Windows 95* in the first 12 months after launch. A facility for subscribing to MSN will be bundled with this. Even if only a small proportion of users take advantage of the opportunity, MSN could provide a serious challenge to CompuServe, America Online and IBM’s new global network.

In addition to providing E-mail and online information services, Microsoft is venturing into the online financial services market, following its takeover of Intuit, the US supplier of the *Quicken* range of personal finance software. Microsoft is working with Visa International to encrypt Visa card numbers for online transactions. Services such as MSN could provide serious competition to conventional banks.

A new company, Microsoft Online Services Partnership, will market MSN. Significantly, ownership is shared with the US cable TV operator, TeleCommunications Inc., reflecting the growing convergence between computing, telecommunications and entertainment technologies. (Source: *Information Management Report*, February 1995)

Medical diagnosis

Bringing the worlds of medicine and information technology together means uniting researchers from all sorts of backgrounds. One force in this grand unification is

the International Consortium for Medical Imaging Technology—ICMIT. After five years' development, it is soon to launch its first products.

The Consortium's goal is to make all the various forms of data generated by diagnostic tests accessible in electronic form, from the breaths heard through the stethoscope to the luminous cross-sections produced by advanced body scanners. When the data are not in digital form, they are often hard to store and to find. Even when the information is already digital, there are at present few standards that allow it to be shared.

With the help of Sybase Systems, a California database company, ICMIT has developed its own database system, the ICMIT Dataserver, and translation systems that, until an agreed standard (DICOM 3) comes into effect, are needed to allow digital information from different medical instruments to be stored for comparison.

In a project sponsored by Hewlett-Packard and Toshiba, among others, ICMIT has developed a storage and retrieval program for still and moving ultrasound images of the heart: it will be unveiled at a meeting of the American Society of Echocardiography in Toronto later this year. The program compresses data 40-fold by concentrating only on the moving objects in a picture. The system filters out noise and so improves the clarity of the final film. Other parts of the ICMIT scheme take image enhancement a lot further. One application is in spotting the bright white calcium spots that indicate malignancy in the fuzzy and confusing images produced by X-ray mammography.

Other programs can make sense of some features on their own. Given a set of cross-sections of a knee produced by magnetic-resonance imaging, it can build up a three-dimensional image, and distinguish between bone and softer tissue.

The goal is not just to make the most out of one set of data, but to be able to combine it with others. ICMIT has matched electro-cardiograms, which measure the electrical activity of the pumping heart, to ultrasound images. A tracker on the EKG indicates the point of the cycle that the ultrasound imagery is displaying. The images can be frozen, fast forwarded or reversed. (Extracted from *The Economist*, 4 March 1995)

Computer user interfaces

Efforts under way to improve computer user interfaces could become a golden key to helping more people become computer users. This would be a welcome boom for the electronics industry since the consumer electronics market represents a huge pool of potential computer customers.

Software giant Microsoft recently released details of a new user interface it calls Bob, which uses animated digital personas to help guide people through their computer use.

Bob users dispense with the traditional desktop metaphor and are faced with cartoon-like rooms populated with "personal guides" which include a rat, a dog and even a "friendly giant". These guides speak to the user to help them access programs and complete various computer tasks.

While Bob may be welcomed by people with a computer phobia, most users will probably quickly outgrow Bob and find it more of a nuisance than a help since it adds extra levels of navigation.

Other companies are also planning computer user interface improvements but with different approaches. Apple Computer, for example, which was the first to successfully commercialize the point and click user

interface based on the mouse and graphics icon approach that is in widespread use today, wants to offer users a choice of different user interfaces in its next operating system called Copland which will be released in mid-1996.

Apple already offers its At Ease interface which is aimed at users with kids and provides children with easier access to their programs while at the same time protecting parents' files from accidental erasure.

A key focus at Apple is to add more intelligence to the user interface in the form of intelligent agents and what it calls "active assistance" in which the computer will be able to understand what the user is trying to do and offer assistance should it be requested. Intelligent agents will be able to perform complex tasks automatically. These tasks might be things like monitoring the performance of investments and making buy or sell decisions automatically or checking banking account balances and making bill payments.

Although Apple's research laboratory, the Advanced Technology Group, has experimented with digital "personalities" like in Microsoft's Bob, it sees limited value in this approach.

Apple is also working on other aspects of the user interface with plans to equip future Macintosh computers with digital cameras and allowing them to recognize who is sitting in front of them. This would provide a level of security in which the computer would give each user access only to certain files or operations.

Speech recognition and text to speech technology is another side of the user interface problem that Apple is working on. Later this year, Apple will announce its text to speech technology that will allow the Macintosh to convert digital text files into digitized speech in a human-like voice. Sophisticated speech recognition and speech to text is another Apple technology that will debut within the next 12 months.

At Xerox, where the graphical user interface was perfected in the mid-1970s before making its way out into the commercial world in the form of the Macintosh and later Microsoft Windows, improving the user interface is a continual process. The Xerox Palo Alto Research Center has come up with several improvements. One of these is Rooms, which was introduced as a commercial product several years ago and uses the room metaphor. Each graphically represented room contains applications and files and various projects that the user is working on. The user can leave a room and pick up another project or task in another room.

Xerox Parc has also developed new ways of finding and using information. With what it calls "information visualizers", files can be viewed not just by their graphical icon, but in a three-dimensional representation that shows how the files are linked to other files. In this way, the Xerox technology can show the context of a file and visualize large, complex hierarchical file listings in a compact and easy to understand form. (Source: *Electronics Weekly*, 18 January 1995)

Making a MES with software solutions

Validated and accurate information is essential to any industry that is subject to stringent regulatory control. Apart from forming the basis for managing a profitable business, information is also fundamental to demonstrating compliance with Good Manufacturing Practice (GMP). All too often, valuable data is inaccessible recorded in

cumbersome paper-based systems or stored within application-specific computer packages. A delay in accessing and retrieving this information may be just an irritation for some employees but for others, particularly those involved in the quality assurance and manufacturing functions, delays may prove critical.

Computer software solutions are now available that integrate the activities of the range of job functions, from production to administration and finance. As a result, the flow of information is eased. Since their development in the USA in the late 1980s, these software solutions have been known by the generic term Manufacturing Execution Systems, or MES for short. MES software integrates day-to-day operational control with other IT systems. It manages all the activities and resources associated with every stage of the manufacturing process: planning and scheduling; tracking, monitoring, control and product history; quality management; and continuous process improvement.

This includes the people, equipment, materials, facilities and customer requirements involved. Through MES, data generated on the factory floor can be fed directly to the various computing systems used for the financial and high-level planning necessary to efficient manufacturing.

IBM was one of the first to enter the MES market with its Process Operations Management System (POMS), introduced in the USA in 1990. Following implementation in the pharmaceutical industry—where close control of manufacturing processes and reliable data storage is essential—it is now proven.

The system's development was based on the needs of the user. The only premise was that the software would facilitate operation of an integrated manufacturing system that could maintain a full range of activities from receipt of orders to finished product. In order to do this, the software had to be capable of automating various activities (e.g., time and attendance, work-in-progress, inventory tracking and job scheduling), and of integrating with both business and process control systems. It had to be a unified system that shared data and infrastructure, and it had to be built on an open architecture to assure a long product life and the ability to evolve with hardware and operating system standards. The result was POMS, which is built on a distributed system design consisting of IBM PS/2s, using OS/2, connected to each other and to a host network. Because POMS is PC-based, it can be installed in stages as required.

With POMS, users create an accurate database of procedures that verify and record events at every stage of the manufacturing process. It guides both operators and automated equipment throughout the process and constantly updates the production database during the manufacturing cycle. Information on, for example, materials used, mistakes, exceptions and equipment behaviour can be shared with other departments such as stock control, QA, engineering, maintenance, planning, IT and finance.

So, with an MES system such as POMS, a manufacturing company can:

- Access and manage process formulations or manufacturing procedures
- Acquire and combine data from different sources
- Translate these data into plant-wide work-in-progress tracking
- Produce real-time production reports

- Provide records of performance and conformance to standards. POMS electronically monitors and enforces GMP on all activities that affect the critical business and quality characteristics of a product.

This technological capability in turn can be translated into business benefits such as:

- Identification and elimination of production bottlenecks
- Improved utilization of resources—e.g., a 5 per cent improvement in throughput is possible
- Improved quality through increased product consistency and "right first time". POMS can be programmed to encapsulate the knowledge of an experienced operator, hence improving the performance of all involved on the factory floor
- Increased yields
- Reduced energy and environmental control costs—activity-based costing can be based on genuine analysis of data available via POMS. With an accurate feel for all relevant data, a company can move towards better control of costs.
- Improved customer service—internally as well as externally

As industry looks to maximize return on investments, dedicated manufacturing facilities are becoming less attractive. For many, flexible manufacturing is the key to competitiveness. As such, MES are likely to be of increasing importance to many companies over the next couple of decades because they are integrated analysis tools, responsive to events on the factory floor, that span the information needs of a wide range of operational functions within any organization. (Extracted from *Manufacturing Chemist*, January 1995)

NTT Data develops satellite data-on-demand system

NTT Data Communications has developed a satellite data-on-demand system which allows calls to be made freely from remote areas for dynamic images and voice which are stored in the server at unattended centres using the communication satellite "JCSAT-2". The new personal computer-based system was developed by using a communication tuner and decoder developed in-house with a mobile earth station. This is the first low-cost and high-performance satellite data-on-demand system to use a communications satellite.

The new system can transfer dynamic images and text data using a communications satellite (CS) between the centre, where the file server is set up, and clients in remote areas. The file server can be connected with multiple information provider (IP) hosts and the contents on the server can be changed.

The clients must install data compression and expansion boards which are sold in stores for NEC's personal computer "PC98".

The clients receive the compressed data from the communication satellite through a receiving flat indoor antenna or a parabolic antenna, 60 cm in diameter. In order to recreate sharp images and data the personal computer is connected to the in-house developed satellite communication tuner and decoder.

The file server and personal computer of the client use the public telephone networks. The IP host and the file server use an integrated services digital network (ISDN) of either 1.5 megabits or 64 bits per second. The data from

the file server is sent to the clients through the communications satellite via a transmission device or large parabolic antenna that is 5.6 metres in diameter.

For example, menus are displayed on the screens of the clients' personal computers. The clients then access the server through public telephone networks to obtain images and text data they need. Then the unattended server will provide the information through satellites to the personal computer. The transfer time, including processing, is approximately two minutes for one megabit image information.

NTT Data claims that the newly developed system is "suited for unbalanced communications systems of the type in which abundant data comes down while only a small amount of data goes up". At present, the company intends to develop an in-house system by April and the clients are scheduled to be located at the company's 10 major stations.

The company plans to actually use the new system for data transfer in the maintenance department where a lot of text data is handled and also for business tools. (Source: *Nikkan Kogyo Shimbun*, 19 January 1995)

Japan develops next generation communications satellite system

The Japanese Ministry of Posts and Telecommunications (MPT) has decided to develop and install the next generation "satellite communication networks" which enable transmission of the large data files required by high quality computer images. The decision was based on the judgement that it is essential to ease congestion in ground cable circuits and to make information available in remote areas of Japan as well as developing countries. Advice on technology standards will be made by the Telecommunications Technology Council (TTC, MPT's advisory body). After coordinating with other concerned ministries and agencies, MPT intends to put priority on this development plan in their budget proposals after FY96. This may encourage the industrial and financial communities to adapt their strategies from their present focus on fibre optic network areas.

MPT is planning to develop and install a satellite communications system with a transmission speed of approximately 1-2 gigabits per second. This capacity is 10-100 times greater than that of NTT's commercially available ground digital communication technology. The new system is capable of transmitting the information contained in an average month's worth of newspapers in 1-2 seconds, and also will enable home access of electronic libraries and transmission of the high quality images necessary for remote medical systems.

As a step toward commercialization of such a satellite communications system, the MPT will ask the TTC to address technical subjects, such as the roles to be played by industry, government and academia in the R&D system, the development schedule and measures for establishing international technical standards.

In addition, a "High Speed Satellite Communications Investigation Research Group" will be formed as a private research group under the jurisdiction of the Communications Policy Bureau Chief. This group will handle the policy aspects of R&D support measures for the communications systems and its system usage technology. MPT hopes that the next generation satellite communications networks will be commercially available within 10 years. (Source: *Nihon Keizai Shimbun*, 17 January 1995)

Complete H.320 kit for Texas MVP

Texas Instruments has developed a software package to support its TMS320C80 parallel-processing DSP that performs all the critical sub-elements of an H.320 ISDN videoconferencing system.

The firm hopes the package will spur videoconferencing system development based on the C80. To date, despite the attraction of the high hardware performance which can realize an H.320 videophone on the one chip, the lack of software has deterred engineers. In particular the crucial ISDN interface software is difficult to develop and not readily available.

The software includes the H.261 video codec and the G.711, G.722 and G.728 audio codec and transport modules. The software will implement a videophone at 30 frames/s at CIF and QCIF resolutions.

The software also includes functions to scale and filter the video display and for inter-image interpolation to increase the frame rate smoothing movement. These functions are part of the H.320 standard but avoid problems caused by the low bandwidth ISDN channel and where the video traffic is multiplexed with other data streams. (Source: *Electronics Weekly*, 8 March 1995)

Software licences

Software licences are notorious for their unintelligibility and their tendency to contain disclaimers and other provisions limiting the rights of the user. The Paris-based European Software Publishers Association (ESPA) recently followed the lead given by its US counterpart in 1993, and published a Model PC Software Licence Agreement.

The Model, intended for the guidance of ESPA members, was introduced partly in response to the EC directive on Unfair Terms in Consumer Contracts, adopted in April 1993. The Unfair Terms directive, however, has yet to be fully implemented in all EC member States, despite the deadline having passed. At the end of 1994, the Benelux countries had yet to introduce the amendments to their domestic laws necessary for compliance.

To ensure compatibility with the national laws of the 12 member States, the Model will comprise a core embodying the elements of EC law common to all, with additions relevant to the national laws of the individual States. To date, the core and the additions in respect of UK law are in place, with other elements to follow.

The Model Agreement could go some way towards solving problems with software licences, but only if adopted by most publishers. So far, the prospect of this happening appears unlikely. Major software suppliers such as Microsoft, Novell and Lotus have been reluctant to give it support. The bigger suppliers claim that they are able to offer a variety of licensing agreements to fit different situations, and that a standard format would reduce customer choice. On the other hand, a number of industry spokesmen claim that a standard would assist smaller software publishers unable to afford the services of expensive lawyers when drafting licences, and would make customers' rights and obligations clearer. (Source: *MicroScope*, 1 February 1995)

Terminological knowledge structure for intermediary expert systems

An intermediary expert system (IES) helps both end users and professional searchers to conduct their online

database searching. To provide advice about term selection and query expansion, an IES should include a terminological knowledge structure. Terminological attributes as well as other properties could provide the starting point for building a knowledge base, and knowledge acquisition could rely on knowledge-base techniques coupled with statistical techniques. The searching behaviour of expert online searchers would provide one source of knowledge. The knowledge structure would include three constructs for each term: frequency of data, a hedge, and a position in a classification scheme. Switching vocabularies or languages could prove a meta-system and facilitate the interoperability of databases in similar subject domains. To develop such knowledge structure, future research should focus on terminological attributes, word and phrase disambiguation, automated text processing, and the role of thesauri and classification schemes in indexing and retrieval. In particular, such research should develop techniques that combine knowledge-base and statistical methods and that consider user preferences. (Source: *Information Processing and Management*, January/February 1995)

Digital piracy

Distributing material over the Internet offers a means of reaching an audience variously estimated at between 10 and 25 million. A growing number of software publishers and a handful of music publishers already make use of it as a means of distribution. Doing so, however, runs the risk of attracting the "digital pirates", who make unauthorized copies, sometimes for resale.

Encryption—using programs which employ separate private and public keys—offers a partial solution. Unfortunately, it offers protection only as long as the encrypted material is on the Internet: once it has been decrypted by a legitimate reader, there is nothing to prevent it being copied and retransmitted.

One new approach is to link the published material to a program which enables the holder of a special password or PIN number to view the text and graphics, or listen to the music. The London-based Cerberus Sound and Vision is using this approach.

The European Union has funded the Copyright in Transmitted Electronic Documents (CITED) project. The CITED model employs a system which resembles that used by Cerberus. Unfortunately, the software is complex and takes a long time to install, and all material to be controlled using the system must be specially adapted. None the less, a new European project, Computer Ownership Protection in Computer Assisted Training (COPI-CAT), is attempting to build a secure CITED system to protect a computer-aided training package.

Yet another approach is to encode a "digital signature" into electronically distributed material. One such coding system is the Universal Data Identifier (UDID). UDID codes—which are able to withstand compression and digital to analogue conversion—could be applied to text, music, video or graphics. (Source: *New Scientist*, 18 February 1995)

Holograms join war against digital pirates

Electronic publishers have two new weapons in the fight against software pirates. One targets professionals who use commercial pressing plants to mass-produce pirate CD-ROMs. The other targets amateurs who can now use a

personal computer and a cheap CD-recorder at home to make copies of high-value ROM discs onto blank CDs.

British company Applied Holographics of Washington, Tyne and Wear, has been working for two years with British CD manufacturer Nimbus on a system which buries a hologram inside the material of a CD or CD-ROM. In the new process, discs are pressed and coated with reflective aluminium in the usual way. Then, instead of receiving an ink decoration, the CD is coated with a clear layer of lacquer. This is embossed with a hologram by a finely engraved printing head. When the lacquer dries it is coated with a further layer of reflective aluminium. This creates a full colour, stereo hologram, sealed inside the material of the disc.

A solution to home piracy is being offered by C-Dilla of Reading. In its new system, the useful data on a CD-ROM disc is encrypted so that it can only be read on a computer loaded with de-encryption software. C-Dilla has found a way of putting the signature onto a pressed CD-ROM so that it cannot be copied onto a blank by a CD-recorder. (Source: *New Scientist*, 18 February 1995)

Drowning in information, but thirsty for knowledge

A lack of structure, not the amount, is the reason for our growing inability to cope with information today. Through the advances of information technology, information has lost the connection with its carrier: therefore, the medium can no longer be used as a reliable indicator of information type. The classical methods of information handling are not sufficient for the growing amount and the new forms of information.

In an information society, the individual needs a more comprehensive system of information management. The suggestion is to use four universal structuring dimensions—selection, time, hierarchy and sequence—and to apply them to information, regardless of the information carrier. Information producers, as well as information consumers, can use this tool-set to profit more fully from the growing mass of information. (Source: *Journal of Information Management*, 15(1)1995)

Software patents

In 1993, the US Patent and Trademark Office (PTO) issued 4,929 patents for software, an eightfold increase over the previous decade. The number is expected to exceed 5,500 this year. The most popular area in 1993 was image processing, with 623 patents, followed by 532 for networks and communications systems. Anecdotal evidence suggests that the US and Japan hold half of all the software patents issued world-wide.

It has been suggested, however, that at least 75 per cent of the US patents granted in 1993 should have been denied on the grounds of "prior art", i.e. previous publication of similar ideas by other people. It is also claimed that innovation is being stifled by the use of patents rather than copyright to protect originators' rights. The PTO is currently investigating whether its standards for assessment are sufficiently rigorous, and whether it needs to recruit more specialists to examine claims for software patents. (Source: *New Scientist*, 4 February 1995)

Eyes, ears and brains on a chip

Printrak International's AFIS (Automatic Fingerprint Identification System) formerly required 28 circuit boards, 7,000 ICs and four 68000 processors. The latest version

(Series 2060), however, performs the same tasks—at far higher speeds—using a single board holding twin DSPs (digital signal processors).

Real-time pattern recognition—whether for fingerprint matching, automatic sorting of mail or speech recognition—has previously required the use of mainframes or expensive dedicated systems such as the former AFIS processor. More recently, however, desktop systems have been coping with recognition processing with the aid of relatively inexpensive DSPs and dedicated processors located on boards plugged into ISA or other system buses. A DSP is essentially a specialized version of a maths co-processor which filters, amplifies or enhances a digital signal (whether audio, video or text data). DSPs are fully programmable, and range from 8-bit fixed processors to 64-bit models.

Another route to faster pattern processing and recognition is offered by the creation of neural networks. The Ni1000 Recognition Accelerator chip, jointly developed by Nestor and Intel, constitutes a neural network computer on a chip. Its 3.7 million transistors support a 1024-neuron network capable of processing between 4,500 and 100,000 patterns a second, about 17,000 operations a second. An ISA add-on card with Ni1000, software and a development system is available for about \$10,000. Applications for Nestor's chip include a vision-based intelligent traffic control system, and an OCR system used by the US Internal Revenue Service. (Source: *Byte*, February 1995)

Chinese pirates target software on CD

As Chinese CD pressing factories are starting to produce pirated computer programs on CD-ROM, software publishers are facing massive losses as counterfeit discs are appearing in the USA, Europe, Australia and throughout Asia. A recent report estimates that the legitimate software industry is losing \$1.4 million an hour through pirating activities. During 1995, 50 per cent of software from leading producers will be available on CD-ROM rather than on floppy discs. China is the major source of pirated CD-ROMS, with Hong Kong being used as an important outlet.

The music industry has taken CD pirates to court in China, so the pirates are now turning their attention to other CD-ROM products. The USA claims to be losing out to the pirates over a wide range of goods amounting to £500 million. The USA has recently demanded that Beijing close down its CD factories that produce 75 million discs a year—25 times China's domestic market. Negotiations broke down at the end of 1994, and China has been told that if it has not complied by 4 February 1995, punitive 100 per cent tariffs will be imposed on exports. China has threatened to take the same action against USA goods. (Source: *New Scientist*, 21 January 1995)

E-mail users face control problems (junk mail etc.)

E-mail is spreading irresistibly, but public attention seems to have been fixed mainly on the technicalities and to have largely ignored the huge changes that are starting to make it business practice. It is generally assumed that all new technology justifies itself by vastly improving productivity and that e-mail will be no exception to this rule, but a survey carried out recently by the European Lotus cc:Mail User Group among 350 corporate information technology managers shows there is a lot of concern

that e-mail may damage productivity unless it is properly controlled.

The IT managers believe that users will need effective filters and agents to ensure that the productivity increases brought about by e-mail are not thrown away because users are reduced to e-mail managing bureaucrats. There are also growing worries about junk e-mail: the electronic equivalent of unsolicited marketing literature. The prospect of being swamped by it may be putting some people off taking e-mail.

Users can choose to block the transmission to their e-mail boxes of selected types of messages, for instance by instructing the system not to access a mass of identical communication to everyone in the office from an unknown outside source. However, this would be done at the risk of excluding some unexpected information of possible great value to some of the addressees. Users can return all the unwanted mail with a note asking the senders not to send anything more of the same kind, but the sheer volume of incoming mail could make this a burdensome task.

Some users are already installing filtering or screening systems which return messages from suspect sources or divert them to a network manager for scrutiny, to ensure the addressee is not bothered with unwanted mail. An example is Beyond's Winrules, distributed in the UK by European Software Publishing. This is a rule based system which allows individual users to dictate precisely what sorts of mail they are willing to receive. (Source: *Information Management Report*, March 1995)

The e-mail effect

Electronic mail (e-mail) has become fashionable as there is something that is both efficient and personal about it that makes it a friendly, acceptable medium. Reasons for e-mail's current popularity are the existence of a critical user mass and, more importantly, the developments—computer, telecommunications link, appropriate software and a "postmaster" that have converged to make it an acceptable communication form. To be effective, the computer should be on the user's desk and dedicated to the use of one individual who has password protection. The computer must be linked either to an internal network or have some kind of dial-up facility. Critical mass can be measured not only in absolute numbers, but also in terms of the proportion of a specific group of e-mail users. The postmaster's role includes ensuring that users have appropriate e-mail addresses and access to their correspondents. Inconsistencies between the scope and flexibility of local look-up tables in one of the biggest remaining hurdles to novice use of e-mail. (Source: *T.I.P. Applications*, February 1995)

Hack attack leaves Internet wide open

The Internet's security watchdog recently reported that hackers had discovered a means of attacking computers previously regarded as safe from intrusion. In the past, computers would exchange passwords before allowing access, until unauthorized users discovered how to detect the passwords as they travelled over the network. More recently, another security technique has relied on electronic "handshakes", or recognition signals, to control access. Now this latter technique in widespread use has also been compromised.

The defensive measure known as a "firewall" distinguishes between a "trusted" computer—perhaps on the

same site—and others, where the type of permitted interactions are severely limited. Authorization is by means of an automatically-generated sequence number. Now some hackers have exploited a weakness in the way some systems generate these sequence numbers to give the impression that they are using a "trusted" node. Development of encryption methods to defeat this is expected to take some time. (Source: *New Scientist*, 4 February 1995)

What a tangled web we weave when first we practice to perceive

The World Wide Web project was developed by CERN (European Organisation for Nuclear Research), a major laboratory for particle physics research. The original design was that of hypertext applied in a networked context. Hypertext permits documents to be automatically linked to other documents, and in turn can be linked to even more documents. The result is a World Wide Web of potentially interconnected information resources, hence the name.

Various procedures are needed to make this concept a reality. First, Internet resources are identified by Uniform Resource Locators (URLs). Second, documents are encoded and formatted with their associated audio, video, text or link components using a standard Hypertext Markup Language (HTML). Third, Hypertext Transport Protocol (HTTP) requests and receives documents from a remote host. The Web operates on a client-server architecture. The server software stores and the client software fetches. Web servers identify themselves by means of an introductory screen called a Home Page. Some Home Pages are distinctive and extremely impressive.

The original Web browsers developed at CERN operated either in text mode on dumb terminals or Graphical User Interface mode on sophisticated workstations. The latter has changed dramatically. The most popular GUI browser originates from the National Center for Supercomputing Applications (NCSA) in Illinois and is called Mosaic. Mosaic is one of many software browsers operating on the Web. Others include Lynx, Cello and Viola. All are publicly available. Commercial browsers, which must of necessity be more robust, secure and polished have been developed and are available for a fee. (Source: *Wilson Library Bulletin*, January 1995)

Internet with style (Netscape rebuilds the WWW)

Marc Andreessen and most of the team that build Mosaic at the National Center for Supercomputing Applications (NCSA) have moved on to produce a commercial World Wide Web browser called Netscape and Web server called Netsite.

Netscape Communications, a company formed from most of the original Mosaic team, has changed Mosaic from the bottom up. Netscape is both visually more appealing and operationally more functional than the original Mosaic. The goal of Netscape was to bring the optimum bandwidth requirements down from 10-Mbps Ethernet speed to a level that is more realistic for the majority of Internet connections: 14.4 Kps, that of a PPP or SLIP connection over voice phone lines. By displaying part of the document before its transfer is complete, there is an improvement in perceived performance. But there are some real performance improvements as well, achieved through a trimmer screen layout, better network communications libraries, automatic caching of previous

pages, and streaming and compression techniques built into the client.

Two servers are offered: netsite Communications Server and Netsite Commerce Server. The first of these is simply a more robust and efficient httpd. Unlike many other WWW servers, it does not require that your server already be attached to the Internet to access documentation allowing you to set up a private web for distributing information with your organization. The second version of the server, Netsite Commerce Server, has secure communications and server authentication. This lets commercial Internet service providers and their customers carry on secure transactions over the Internet. (Source: *Byte*, January 1995)

Training in multimedia: not just for hackers any more

Education and training in the field of multimedia CD production is becoming available. For prospective CD publishers considering video as part of their end product, OptImage offers a new digital video training course—Introduction to Digital Video. This course is a one day intensive look at digital video and the production issues associated with it. Classes focus on MPEG standards, software tools, production paths and production of Video CD and CD-i titles with digital video assets. Students record, encode and author their own titles while learning the technical ins and outs of digital video authoring.

Wadsworth Publishing Company offers Video Lab, an interactive learning tool designed to teach the basic skills of video production. The CD covers five main video content areas: camera, lighting, audio, editing and process. The setting is a fictitious video production studio. Video Lab is aimed at adults and students who are pursuing a career in video production or need to improve their video literacy for current or future jobs.

For those publishers already involved in CD production, a new tool helps unveil the mysteries of the ISO format. CD Workshop, from Incat Systems, is a software diagnostic tool for CD-ROM production. CD Workshop can be used to examine any CD image on compact disc or hard disk. It reports general disc information such as the number, types, lengths, and modes of track/session on a disc. A user can check the integrity of the image and the contents of Volume Descriptors, Path Tables, Directory Records, and more. (Source: *CD-ROM Professional*, January 1995)

Ipv6—the new Internet protocol

Response times on the Internet are slow when making contact with services, transferring files and downloading graphics or sound files. The Internet Protocol has held the network together, but is coming under strain as the 32 bits used for the address, which allows up to four thousand million addresses, is proving to be too small and there are associated problems with the routing system. Another limitation is security, as no security features are provided at network level. This means that a new protocol is being planned by the Internet Engineering Task Force (IETF). The resulting Ipv6 (Internet Protocol version 6) builds on version 4 and a major feature is the expansion of the address length from 32 to 128 bits. Classes of service are defined so that a video message, for example, can be assigned the fastest available route, and authentication and privacy features are built in. If the new protocol works as

anticipated, it should be a flexible protocol that will allow for any conceivable rate of user and service growth. It will provide conventional users with a wider choice of services and faster and more reliable delivery. The new protocol is being introduced incrementally and more information is available on the IETF's World Wide Web home page. (Source: *IT Link*, 1995)

Preparing to document an object-oriented project

Documenting object-oriented (OO) projects is a new challenge for many technical writers. These OO projects are based on three central concepts: encapsulation—self-contained modules of code defining program data and the operations that can be performed on that data; inheritance—the capability of OO systems to create new kinds of objects derived from existing objects; and polymorphism—the same message having different meanings for different objects. OO programming has important implications for development organizations, as programming productivity can increase because so much code is reused; quality generally improves and maintenance is made easier by the modularity of OO programs. The difficulty of learning the OO approach should not be under or over-estimated. Experienced OO programmers find it difficult to explain their techniques to novices. The most popular OO programming languages are C++ and Smalltalk, and the latter is probably the best choice for a beginner. OO programs are made up of self-contained objects, each with a documented interface.

The writing team needs at least one information designer or architect to develop any prototypes and a combination of novice and experienced writers to fill writing assignments. OO programming requires the use of iterative development processes, which may be problematic for writing teams, as adapting to true iterative development is not easy for any team member. It is important not to get too attached to the design created for the first iteration because it may be necessary to start again after feedback from customers and programmers. Documentation prototyping is important for any OO project that follows an iterative process. A prototype is a model showing how completed documentation will look and it can help to pinpoint the knowledge level and sophistication of readers. Style guidelines and consistency guidelines specify how a document should appear to the end user, and the prototype can help decide whether to produce traditional hardcopy books or online documentation. It is concluded that

technical writers can expect to encounter a variety of challenges and new experiences when developing project documentation for an OO project. They should consider the importance of education, the potential time savings to be found for reuse, the impact of staffing, and the need to follow a set development process. (Source: *Technical Communication*, Fourth Quarter, 1994)

Charging for publications on the Internet

With increasing commercial interest in the growth of the Internet, and particularly the World Wide Web, there is a considerable demand for charging systems that will allow information, service and product providers to charge when their customers are online. A number of system proposals at various stages of development have now begun to appear, amongst them ECash and NetBill. ECash is a WWW based product from DigiCash which has a number of secure charging systems in its product portfolio.

ECash was announced at the WWW94 Conference in CERN earlier on, and many more details have now become available. ECash makes use of the principal of electronic tokens which represent specific units of real money. To buy tokens and have them credited to an electronically accessed ECash account, DigiCash is proposing that a bank would be able to do this as a support service. ECash would be debited against a conventional account and credited to the electronic account.

The School of Computer Sciences (SCS) at Carnegie Mellon University has been working for several years to produce an optimized system for electronic publishing. The result of this research is NetBill, a prototype Internet Billing Service (IBS). The prototype provides account management, authentication, access control, credit verification, management reporting, billing and collections services. The prototype, NetBill, is an ongoing project and further developments are expected to be announced shortly. Security is provided using a system of encryption and passwords. Currently, the prototype IBS provides a means by which end users can establish an account relationship with the Billing Server. This arrangement also offers a method for the information provider to create accounts which use the server to bill the end user. Apart from authenticating the identity of both user and supplier, the server is also able to restrict the end user to a specific set of services or alternatively a list of services which cannot be accessed. (Source: *Electronic Documents*, 3(12) December 1994)

G. COUNTRY NEWS

China

China backs giants for first division status

China is aiming to have several companies in the world's top 500 electronics firms by the year 2010 by adopting the European strategy of backing a small number of electronics "giants".

The Chinese electronics industry ministry has announced a programme to back four or five electronics companies, which are expected to have sales of \$1.7 billion to \$2.35 billion by the end of the century. It is anticipated that exports will account for more than 30 per cent of their total sales. Over 3 per cent of their sales will be invested in R&D and products.

In 1994 the ministry gave special support to four large companies: Shanghai Audio and Video Co., Legend Group, China Panda Electronics Group and Changhong Electronics Co. Sales of Shanghai Audio and Video, Changhong and Panda were expected to exceed \$588 million each last year.

This year the ministry intends selecting a group of companies and granting them the same preferential treatment as that given to overseas investors, including special loans to support development of new technology and high-tech products.

Production of electronics goods grew by a record 31 per cent in China last year to reach \$22 billion. As a result taxes and profits going to the State were more than \$1 billion, up 29 per cent on 1993. Production this year is expected to surge ahead by another 20 per cent to \$26 billion, resulting in the State taking \$1.4 billion. (Source: *Electronics Weekly*, 25 January 1995)

Chinese smart card network

Schlumberger, the international smart card technology giant, is working with the Chinese Government on a huge project in China that will introduce smart cards for banking, health, identification and utility-metering applications. The project, named Golden Card, is part of an \$8.8 billion scheme designed to provide China with a nationwide information network based on smart card technology. It is expected this project will result in 200 million cards being issued in China by the year 2003. (Source: *Electronics Workshop*, 26 April 1995)

China logs on to the Internet

China's first direct commercial links to the Internet have been approved by the Government and are due to begin operation. Two dedicated lines, one from Beijing and the other from Shanghai, will allow everybody in China with a computer and a modem to tap directly into the full range of the Internet's resources. Jointly operated by Sprint, an American telecommunications company, and China's Ministry of Posts and Telecommunications, the new lines are expected to be wildly popular. Sprint says it will probably need to expand the lines' capacity within a few months to accommodate expected growth in demand. (Extracted from *The Economist*, 7 January 1995)

European Union

Competitive fourth framework programme

The proposed European fourth framework programme allocated a micro-electronics budget of about \$540 million from a total Information Technology budget of \$4,180 million. The programme shows the European Commission wants to encourage manufacturers to keep up with US and Japanese technology by developing 0.25 μm CMOS technology and even finer linewidths.

By 1996 the programme intends:

- 0.35 μm state-of-the-art CMOS technology to achieve qualification on at least two sites;
- A fully economized CMOS process will be consolidated in a number of European facilities;
- Qualification of a BiCMOS process for state-of-the-art analog-to-digital converters.

Other aspects of this programme include the perfection of gallium arsenide process technologies for multi-chip modules and for optoelectronics with special attention being given to particular requirements in materials, packaging, manufacturing and compatibility among different processes. It also is intended to demonstrate the commercial effectiveness of integrated silicon-germanium technologies in bipolar and CMOS technologies. (Reprinted with permission from *Semiconductor International Magazine*, January 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA)

France

Gemplus to supply Russian bank

French smart card producer Gemplus is to supply the Russian bank Credit FD with smart cards for Russia's first smart card banking system. The smart cards will be hybrids, incorporating both a magnetic stripe and a smart card chip. The installation of the PCOS (Payment Chip Operating System) has already been completed in the Russian town of Berezniki by Interlink Computer and Software Company. (Source: *Electronics Weekly*, 19 April 1995)

Germany

All-in-one traffic system in road trials

A car telemetry unit that combines a GSM mobile telephone, global satellite positioning and smart card technologies may soon be on its way.

A terminal that consists of a control unit based around a microprocessor, GPS unit, GSM unit and a smart card is about to be used in the German motorway trials to evaluate road tolling and electronic navigation systems.

The terminal is a result of a memorandum of understanding signed by Motorola, Siemens, Bosch, DeTeMobil (the mobile branch of Deutsche Telekom), AEG-Mobile Communications, Nokia and Orga at the end of 1994.

The companies have agreed to a common hardware and software architecture to implement in a standard communication interface for connecting peripherals in vehicles.

Up to now, route guidance, traffic information, road-toll collection, vehicle security and any vehicle-to-vehicle or vehicle-to-infrastructure communication was only possible using several separate units. The new terminal abolishes the need to have so many units and sets up a standard for connecting future devices inside the vehicle and connecting to external devices.

The unit is expected on the market by the end of the year. (Source: *Electronics Weekly*, 8 March 1995)

Karlsruhe Nuclear Research Centre studies energy-saving technology

By its very nature electrical energy cannot be stored directly. Current indirect storage methods lead to various degrees of power loss, depending on the method employed. In the case of mini- and micro-energies this hardly matters, but the losses tally up to sizeable drains in the case of power-producers and systems operators. At present they are circumvented through various energy storage technologies whose costs, however, more and more operators would gladly like to avoid, given the ecological pressures and regulations.

This is where superconductivity opens up fresh technological possibilities for storing electrical energy for extremely long periods of time by storing it in a ring of superconductive alloys and "securing" it inside the ring at extremely low temperatures of a few Kelvins using liquid helium. Electrical energy also produces extremely powerful magnetic fields that are maintained for a very long time at superconductor temperatures. Physicists have been acquainted with this phenomenon for a long time now, but it has still not been exploited on a commercial scale because of the anticipated high construction and installation costs and a lack of experience.

At an international gathering of experts at the Karlsruhe Nuclear Research Centre [KfK] recently, German utility companies too showed increasing interest in that technology. It seems to be a promising way of increasing the efficiency of power generation, economizing or reducing investment costs for new peak-power generating systems and at least partially or temporarily skirting the looming emissions regulations for large facilities.

Studies are currently being elaborated in the Nuclear Research Centre, concentrating on two storage processes: the first alternative entails the building of large flywheels that will convert the electrical energy into rotary motion with minimum loss and that could instantaneously activate power generators if a demand for peak power emerged. The other alternative is superconducting field coils that could be operated without friction loss using liquid helium.

Because of their enormous dimensions, technological virgin territory would have to be entered in both processes. Still, according to the Karlsruhe Nuclear Research Centre GmbH, a start can be made with the design of smaller storage systems to meet industrial demand; for example, in the steel industry, for rolling mill systems or in the paper industry, if high energies are required for a short period to start up the drive motors. (Source: *Frankfurter Zeitung*, 9 November 1994)

Japan

Moves on car radars

Japan's Ministry of Posts and Telecommunications is set to steal a march on the United States by

first country in the world to allocate a frequency for the use of collision-avoidance radars in cars.

The MPT is believed to be about to allocate a band of frequencies at 60 GHz for vehicle radars, which will be a key part of advanced cruise control systems that automatically keep cars a safe distance apart.

Japanese car makers and after-market car parts suppliers are eagerly awaiting the MPT approval, expected shortly. Equipment makers predict that radar systems may be installed in more than 7 million vehicles in Japan by the year 2000.

Several US vehicle manufacturers are developing car radars, including Ford and General Motors. (Source: *Electronics Weekly*, 5 April 1995)

Computers cleaned

Fujitsu of Japan has developed an alternative to trichloroethane detergent for printed circuit boards.

Marketed under the brand name Perclean, the company claims the detergent is better at cleaning than trichloroethane.

The new detergent is a mixture of hydrocarbon, polar solvent and acetic acid, and can wash off the flux used for soldering in the print circuit board assembly, as well as the flux resins in central processing units of supercomputers.

The Montreal Protocol Treaty Conference announced a ban on trichloroethane from the end of 1995.

Fujitsu is studying the feasibility of marketing the new detergent through chemical manufacturers. It plans to market the detergent at a lower price than other alternatives. (Source: *Manufacturing Chemist*, February 1995)

Micromachine technology

The ultimate goal of mechanical engineering is to replace human functions and labour by machines. To reach this advanced state, we must develop machines as clever as ourselves, and enable them to move according to their own decisions as our body does.

To meet the second requirement, it is necessary to make machines much smaller, as may be realized from the fact that human movements rely on cells and their constituent substances including proteins and other biological molecules.

Reducing machine dimensions has lagged behind the R&D of intelligent machines. However, this challenge must be faced for the progress of mechanical engineering. Developing micromachines may provide us with great innovations in industrial technologies as did the development of intelligent machines.

Unfortunately, micromachinery has not found any definitely promising applications yet. Worse, the research investment will certainly be huge. In the private sector, therefore, research of micromachines will be too limited to achieve technological innovation.

Japan's Industrial Science and Technology Frontier Programme has been set up to develop micromachine technology to strengthen industrial technologies as well as mechanical engineering.

The project was commissioned by the New Energy & Industrial Technology Development Organization (NEEDO) from the Micromachine Centre so that the private sector can undertake the research and development of micromachines. There are also three government institutes joining the project: the Mechanical Engineering Laboratory,

Electrotechnical Laboratory and National Research Laboratory of Metrology.

In R&D of micromachines, many problems may arise because the dimensions concerned are very small. A conceivable problem is that frictional efforts will become more significant. Another is difficulty with energy transmission. Unforeseen problems may also appear. In Phase I, therefore, only component devices will be tentatively made and tested. On the basis of these findings, the general plan of Phase II will be prepared before Phase I ends.

There were no known specific applications of micromachines when Phase I started. Three promising sectors were thus taken, and their mechanical elements were investigated. The three sectors are:

(1) Advanced Maintenance System for Power Plants

This is a micromachine system for the maintenance of fine tubes in power plants. The system will consist of a microcapsule, a base machine, inspection module and operation module. Necessary mechanical components (e.g. microscopic power generator and energy transmitter) of the system have been specified. The component devices are being fabricated.

(2) Medical micromachines

Micromachines are applicable to examination and treatment inside the body cavity. A micromachine will possibly be inserted through a catheter for diagnosing and curing, for example, cerebral thrombosis and aneurysm. Component devices of such medical machines are being fabricated.

(3) Microfactories engineering

A system for manufacturing tiny precision parts of watches, cameras and electronic appliances with much smaller production equipment than predecessors. The system will greatly reduce energy consumption in production. The miniature equipment should be no larger than 2-10 times the size of the product. Component devices of the equipment are being fabricated.

Basic research on devices has been conducted with micromotors a few millimetres across, various micro-actuators and methods of joining microscopic components. The research has progressed enough to construct a machine a few millimetres across.

The research up to now has revealed many challenges to be met in future research.

There are two prominent areas: (1) to specify and solve problems arising when a micromachine is assembled from component devices, and (2) to evaluate every device by engineering methods and modify the design. Priority will be given to solving those problems. (Source: *JETRO*, November 1994)

The Netherlands

Handling full text electronic documents: a report on the Dutch SURFdoc project

The aim of the SURF Foundation is to encourage the use of information technology in higher education institutions in the Netherlands. Its Scientific and Technical Committee published *IT in Perspectief (IT in Perspective)* at the end of 1991. This identified document delivery as an area requiring special attention. Accordingly, a project

intended to develop a pilot for automatic document delivery was defined, and the study phase approved in 1992.

The resulting report, *Survey of document delivery projects and services*, has since been updated twice, and the latest version (dated February 1994) is available electronically. The study revealed a low level of usage of such facilities. A number of recommendations were made, aimed at improving take-up. They included increased cooperation between libraries and computer centres, the development of standards and the negotiation of copyright agreements with publishers.

The implementation phase of the ensuing SURFdoc project was completed in February 1994 and demonstrations were made towards the end of the same year. There were three main components of the project: cooperation between libraries and computer centres in the university environment; processing images in end-user environments, using "off-the-shelf" hard- and software; and the storage and distribution of electronic documents held on a fileserver. Four institutions—the universities of Groningen (ELDORADOC), Leiden (OASIS), Utrecht (IRIS) and Tilburg (Library of the Future)—participated in the project.

The article outlines the progress made at each university and the conclusions emerging from their experience. (Source: *Journal of Information Networking*, 2(2) 1994.

Russian Federation

Russia moves from plutonium to silicon

The Russian Ministry for Atomic Energy is investing heavily to convert its nuclear facilities into 6 in. silicon wafer processing plants. It has already placed a \$54 million order with Tokyo Seimitsu and American-based Silicon Technologies for silicon processing equipment.

A formal agreement with these companies is expected later this year, after which time the Ministry hopes it will take only 12 months to complete the transformation. But some experts think this will be a tough task to achieve. (Source: *Electronics Weekly*, 11 January 1995)

United Kingdom

UK teams bid for EC chip making funding

Around 30 UK-based semiconductor firms and universities are coming forward to bid for a share of the £10-12 million funding offered by the European Commission under the IV Framework Semiconductor Equipment Assessment Initiative.

Funding for the Semiconductor Equipment Assessment Potential Sites (SEAP) group is intended to ensure that Europe remains at the leading edge of future semiconductor manufacturing technology.

Projects put forward so far include 0.25 micron lithography, low pressure chemical vapour deposition (LPCVD) for high frequency circuits, ion implantation for the production of flat screen displays and direct writing of 0.25-micron patterns or finer for ASICs. (Extracted from *Electronics Weekly*, 22 February 1995)

LINK scheme improved

Improvements have been made to the UK Government's LINK support scheme, aimed at initiating collaborative R&D projects between science and industry.

LINK is being modified so companies and universities can start joint projects more quickly.

Following a review of the scheme in 1994, a new board will replace the LINK steering group. The Board's main role will be to take an independent strategic overview of the portfolio of programmes and advise on how LINK should respond to the emerging findings of the Technology Foresight programme. (Source: *Electronics Weekly*, 22 March 1995)

UK growth best in world

UK and Ireland's semiconductor market will outstrip the rest of the world this year, with IC growth expected to top 28 per cent, according to the Federation of the Electronics Industry.

The figures predict the British Isles IC market will grow by 28.6 per cent to £3.8 billion this year.

Earlier, Dataquest predicted the world market could see a 20 to 25 per cent increase this year.

According to the FEI, discretes will contribute another £393 million, 19 per cent up on last year, bringing the UK/Ireland semiconductor market to £4.2 billion (\$6.4 billion). (Source: *Electronics Weekly*, 22 March 1995)

United States of America

The clipper chip and the price of security in America

As a great deal of information is travelling across telephone lines and through the air, electronic crime has become more common and sophisticated. In April 1993, the US National Security Agency (NSA) introduced the clipper chip to protect all transmitted information. The idea is that only law enforcement agents are able to listen to the encrypted conversations after obtaining a warrant. The chip transforms all communications into a cipher text which is an unintelligible signal or text produced through the use of a cryptosystem. The clipper chip has crypto-algorithm written in it which is called the "Skipjack" which is a top secret algorithm. The chip runs at 12 megabits per second and enciphers 64-bit blocks of data by using 80-bit keys, and it has a two-key escrow system.

Apart from its complexity, there are problems relating to trade; effectiveness; constitutionality; reliability; and necessity. It is concluded that the proliferation of strong, public encryption programs has caused the NSA to worry as it takes more time and resources to break the code. Public-key encryption programs are powerful because they are so widespread. Criminals in the future may have an encryption device that even the NSA cannot decipher and introducing the clipper chip will not solve this problem: it may only slow the development of commercial encryption programs. (Source: *Information Management & Computer Security*, 2(5) 1994)

Self-help for electronics

The American Electronics Association is establishing an independent organization to start an industrial loan

company solely to fund emerging electronics companies in the United States.

AEA boss Darrell Wilburn described the project as an "industry self-help group to jump-start small and medium sized electronics firms".

The group will function as a private financing company. Funding will come from other electronics and computer companies, although not necessarily AEA members. (Source: *Electronics Weekly*, 8 February 1995)

New version of the National Technology Roadmap

The US Semiconductor Industry Association has completed the first revision of its National Technology Roadmap for Semiconductors. The purpose of the Roadmap "is to provide a quality database of needs and a framework by which the semiconductor community can systematically approach the enormous R&D required to meet those needs".

The revisions were crafted over the course of 1994 by eight different Technology Working Groups called "TWGs", which reported to a Roadmap Coordinating Group (RCG).

The primary focus of the Roadmap is on technology required for silicon CMOS integrated circuits.

A new part of the Roadmap that was not addressed in earlier efforts is the so-called "crosscutting" technologies that are common to many of the specific Technology Roadmaps. Each TWG was asked to address six crosscutting technologies—contamination-free manufacturing, materials, metrology, modelling, standards, and quality and reliability—as they developed their revisions.

A special section also calls out Grand Challenges that "demand special attention of the semiconductor community leadership". These challenges are productivity improvement, complexity management, advanced technology development and technology development funding. (Extracted with permission from *Semiconductor International Magazine*, January 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA.)

Congress plans to cut LCD research cash ...

US efforts to establish a world class flat panel LCD industry could be jeopardized by US Congress plans to cut \$15 million from two key projects.

The House Appropriations Committee has voted to reduce funding for the US Display Consortium by \$8 million and cut \$7 million from funds earmarked for Silicon Video, which is building a pilot flat panel LCD production facility in Silicon Valley.

Democratic members of Congress blamed the Republican-controlled Congress for the proposed cuts.

Flat panel LCD displays are seen as crucial in next generation computer systems and in the developing HDTV industry. (Extracted from *Electronics Weekly*, 22 February 1995)

H. AUTOMATION

World's smallest microrobot

Seiko Epson Corporation has started marketing the world's smallest microrobot called Neenyo. The company marketed the world's previous smallest robot Mushu in 1993 that was registered in the Guinness Book of Records, but has now developed a new drive chip that is the controlling factor for miniaturization. The new microrobot has a volume of only 0.5 M³, roughly one half that of the Mushu robot and is being marketed to amusement equipment manufacturers.

Neenyo is 10.3 mm (depth) x 8.5 mm (width) x 8.6 mm (height) and, as with Mushu, when exposed to sunlight or artificial light, the sensors fitted into its eyes detect the light and the robot accelerates towards the light source. It also incorporates a mode for remarkable motions when manipulated.

The robot body made of sterling silver incorporates a total of 96 parts including a pair of drive chips (each 6.1 mm x 6.1 mm x 1.7 mm), ICs, crystal oscillators, and power unit capacitors. The microrobots are assembled individually by skilled time-piece assemblers. The slope climbing capacity is 5 degrees and the maximum forward advance speed 16.8 mm/s. The company observes that the microrobot manufacture is based on its advanced precision processing technology.

Further details from: Seiko Epson Corporation, Public Affairs Section, 3-5, Owa, 3-Chome, Suwa City, Nagano Pref. 392; Tel.: +81-266-58-1705, Fax: +81-266-52-8775. (Source: *JETRO*, February 1995)

Humanoid robot with mechanical phonetic organs

Professor Y. Tanaka and his research team at the Department of Mechanical Engineering, Hosei University, have developed a human-like robot that utters sounds by the mechanical method, and not by the usual electrical approach.

Sounds uttered by the human vocal cords pass through the vocal tract, larynx and oral cavity as well as resonant parts such as the teeth and lips and become vowels

and consonants. The new robot slides the blocks corresponding to the respective sounds and changes the variable-section rectangular air channel, in which the air corresponding to the fundamental sound resonates to modify the sound.

Up till now, research has been conducted actively on voice reproduction by electronic means, but research on mechanical methods is rare. An example of the mechanical method is the mimic vocal cord, a fundamental sound generating mechanism fitted to a patient who has lost the functions of the vocal cords, but this is only a supplementary measure.

The research team developed a robot displaying the functions of a phonetic mechanism, just like a human being. The human vocal tract is mimicked with a rectangular air channel block, fundamental sounds are generated by passing air from an air pressure source into the vocal cords model, then fundamental sounds are input into the resonant model, by which sound is regenerated from the resonance characteristics.

The prototype robot consists of the compressor serving as the source of pneumatic pressure, a fundamental sound generator using a rubber film 0.3 mm thick, and duct type resonant parts made of acrylic blocks. Each of these resonant parts consists of eight slidable blocks with an area of about 2 cm wide and 4.5 cm long arranged alongside each other, and joined together with a stepping motor and ball screws. The blocks slide into the required rectangular sectional shape in conformance with the respective sounds.

At present, only vowels are generated, but not in the form of words. Research will be advanced on the consonants and on the nasal of the Japanese language with the aim of generating continuous sounds.

Further details from: Hosei University, Dept. of Mechanical Engineering, College of Engineering, 3-7-2, Kajino-cho, Koganei City, Tokyo 184; Tel.: +81-423-87-6133, Fax: +81-423-87-6121, E-mail: tanaka@ctrl.me.hosei.ac.jp. (Source: *JETRO*, March 1995)

I. STANDARDIZATION AND LEGISLATION

The gold standard (CD-Recordable standards)

Many companies are now contemplating the use of CD-Recordable (CD-R) technology as an inexpensive, secure and standardized replacement for floppy discs, hard drives, tape, microfiche and other optical media such as magneto-optical and WORM. In addition, many are using CD-R to test applications before committing the data to mass-produced CD-ROM. Sales of CD-R units in the US have been forecast to reach 1.5 million by the end of 1995.

This increased interest in CD-R has been encouraged by the dramatic fall in the prices for CD-R drives, software, media and CD-ROM drives. In five years, the price of CD-R systems has fallen from \$100,000 to under \$5,000, and is expected to fall below \$1,000 this year.

If CD-R is to fulfil its potential, however, further cooperation between the manufacturers of drives and media will be required. The Orange Book specification for recordable media defines the standards to which the discs must conform, but not the process by which the blank discs are manufactured. Every manufacturer uses a different, sometimes proprietary, method, and as a result, some CD-R discs will work in one CD-ROM drive, but not in another. Other problems of software compatibility can arise. The SCSI specification includes a command set for CD-R devices, but is incomplete, leaving manufacturers to define their own command set. These differences require software developers to write different code for different drives.

Another issue is that of longevity. This is not important if the CD-R disc is used as an input medium for mass replication, but is if it is used for storing medical or legal records. Whether CD-R discs will last longer than mass-produced discs is not known. (Source: *CD-ROM Professional*, February 1995)

EC moves on telecoms standard licensing

A new European telecommunications standard licensing scheme which must take account of privately held intellectual property rights (IPRs) has been cleared by the European Commission. Under the new scheme European telecommunications standards body ETSI can no longer deem any privately held IPR as essential for a specific technical standard, making it openly available to all manufacturers. The individual IPRs of companies must be taken into account when creating standards. This will avoid a repeat of the IPR row which followed the creation of the GSM digital cellular telephone standard. However, the proposal may limit access to technology used in future telecommunications standards. (Source: *Electronics Weekly*, 5 April 1995)

Intel rolls out bid for more functions

Intel will propose a new bus standard with details of its native signal processing specification as part of a bid to add more functions to basic PC motherboards.

Intel's proposed universal serial bus (USB) will transfer data at 1.5 Mbyte/s, more than tripling the rate of standard serial port data transfer speed - about 400 Mbyte/s.

USB is described as an asynchronous bus capable of supporting up to 128 peripherals in a daisy chain. It will also support Microsoft's Plug and Play specification, which

seeks to make it easier to connect peripheral devices to PCs.

Computer companies expected to announce their support for USB include Microsoft, Compaq Computer, IBM, DEC and NEC. (Source: *Electronics Weekly*, 22 March 1995)

Analogue videophone standard

Telecommunications manufacturers and operators plan to finalize a videoconferencing standard by the end of the year which will support videophone and data services over existing analogue telephone lines.

In February, the standards committee of the ITU approved a first draft of the H.324 videoconferencing standard, which is the analogue line equivalent to the H.320 ISDN-based standard. The intention is to have a final draft ready by November 1995 and the first analogue PC videophone cards are expected to appear early in 1996. It is the first true international analogue videophone standard and will effectively kill off attempts by BT and AT&T to impose proprietary protocols.

To keep cost and development times down the standard will lean heavily on existing data transmission protocols and silicon. H.324 uses the V.34 28.8 Kbit/s data modem protocol, and the channel is divided into a 5.3 or 6.3 Kbit/s audio stream leaving around 22 Kbit/s for the compressed video.

The standard is expected to support a number of levels of video compression, giving a range of picture quality options from a basic six frames second up to 30 frames second. The core video compression is the discrete cosine transform (DCT) based H.261 algorithm used in the H.320 digital standard. Although H.261 uses both intraframe and predictive interface coding, the new standard incorporates an enhanced level of motion compensation and bidirectional frame prediction. To achieve the level of data compression needed to squeeze the 30 frames/s video picture into a 20 Kbit/s stream an interpolated motion estimation on P and B frames similar to that used in the MPEG standard is implemented.

The principle behind motion estimation is that by predicting how the image changes from frame to frame, less picture information has to be transmitted for each frame. Unlike the H.261 motion compensation algorithm, which executes a series of search and comparison operations with respect to the previous frame stored in a buffer memory, H.324 estimates the pixel content of any frame by comparing the images in both the previous frame and a prediction of the next future frame.

The content of the frame is the average of the picture block changes from past to future frames and significantly reduces the amount of picture information which must be transmitted.

The resulting data compression doubles the achievable frame rate for only a 20 per cent increase in the transmitted data rate. H.324 specifies a quarter-CIF picture resolution at up to 30 frames/s.

A new audio compression algorithm has been defined which is more efficient than that used in H.320 and specifies either 5.3 or 6.3 Kbit/s audio channels. There is also

provision for a separate data channel, which uses a variable portion of the video and audio channels. (Source: *Electronics Weekly*, 8 March 1995)

Standard introduced for squeezing video on phones

The transmission of video pictures of acceptable quality over the standard analogue telephone line is only achievable if the associated speech occupies less of the available channel bandwidth.

The ITU has recently approved an audio compression standard that squeezes telephone quality speech into a channel with a fraction of the bandwidth of a traditional 64 Kbit/s PCM telephone speech channel.

The ITU's new analogue videophone standard will use the 28.8 Kbit/s modem data rate, but over 20 Kbit/s of that channel bandwidth is needed for the 30 frame/s compressed video stream. The speech compression standard, agreed in March 1995 and designated G.723, is intended to operate at data rates of 6.3 and 5.3 Kbit/s.

The new standard was based on an amalgamation of the compression algorithms developed separately by DSP Group/AudioCodes and France Telecom with the University of Sherbrooke in Canada. The principal speech coding is accomplished by a version of DSP Group's TrueSpeech algorithm, which is already being used by Intel and Microsoft.

In addition, the standard incorporates a flavour of the CELP compression technique to support multiple compression operations needed for multipoint video-conferencing.

The 6.3 Kbit/s version of TrueSpeech algorithm is based on a multipulse maximum likelihood quantization (MP-MLQ) low rate speech coder developed by AudioCodes, the Israeli affiliate of DSP Group.

The MP-MLQ speech coder uses a tenth order linear predictive coding (LPC) scheme to derive the filter coefficients of a time varying linear digital filter that perform the spectral shaping of the audio input.

The LPC filter samples a 30 ms speech frame at 8 KHz and the output is a 16-bit linear pulse code modulation (PCM) data stream. Each 30 ms frame divides into four sub-frames and tenth order LPC filter coefficients are computed for each sub-frame.

The MP-MLQ speech coder has been designed to be implemented on a 16-bit fixed point DSP, such as Motorola

DSP56156, running at 18 MIPs. It requires 2,240 16-bit words of RAM and 9,100 16-bit words of ROM for look-up tables and 7,000 16-bit words for program memory. Overall system delay is 97.5 ms. (Source: *Electronics Weekly*, 29 March 1995)

Learning the highway code (legal issues on the superhighway)

There are some emerging legal issues facing those who build, provide content for and use the superhighways. Copyright is perhaps the biggest single question. This includes the issue of how content providers should be protecting digitized works by copyright and how users and developers can gain access to such works by affordable and practical means. Important patent issues have also emerged, especially on the patenting of allegedly routine multimedia search techniques and software algorithms.

A second issue is data security. Naturally, businesses and individuals will hesitate to upload vast amounts of valuable content or commercially sensitive information if it can be readily hacked into, manipulated and stolen. Personal privacy is also at risk in situations where voice, data and photographic images can so readily be distorted without the knowledge or consent of the data subject.

Digital piracy is a third concern for owners of films, books, music and images. They have reputations to protect and marketing control to exert, but they fear losing their prized assets in a networked digital nether world. While copy prevention devices are being developed at a rapid pace, recordable CD-ROM equipment threatens to make off-line piracy extremely easy, and this is heightening fears.

The fourth issue is cross-border liability. It can be difficult to escape liability (for instance, for libel or trade mark infringement) in a single country. When electronic services are distributed across borders, however, the risks appear to multiply.

The fifth issue is liability for content of messages on bulletin board services, where prosecutions have been made. The sixth issue to look at is unfair competition, which will have a major role in regulating the superhighways. Market leaders risk acting unlawfully if they try to abuse their proprietary technical standards to gain business advantage over competitors. (Source: *Information World Review*, December 1994)

J. RECENT PUBLICATIONS

Full text

The number of electronic full-text sources is exploding. In addition to international sources, trade publications, and newspapers, there are new broadcast transcripts, professional journals, magazines, loose-leaf services, and news-wires going online every month. In addition to the databases, which increased the number of full-text titles carried by 15 per cent from mid-1993 to mid-1994, they are also appearing in the form of customized news services using dedicated lines to deliver information directly to the desktops of end-users; they are appearing on consumer online services; and they are showing up in multimedia formats on CD-ROM. There is also the Electronic News Stand, the gopher-accessible site on the Internet offering access to dozens of current titles.

The rush to present traditional products in new and unconventional ways has resulted in some experiments that fiddle with the basic fundamental purpose of the original, as well as changing the form or method of delivery. News-week Interactive on CD-ROM, for example, is not a news weekly at all, but rather a quarterly amalgam of source material from the traditional magazine revamped with sound and video to become more of a multimedia mini-encyclopaedia, covering selected topics in an educational presentation.

As the corporate mergers between information producers and communications companies continue, the media will continue to play with conventional information sources in order to make them what they think is more accessible, converting them to various electronic formats while trying to capture the imagination of the marketplace by out-dazzling the competition. Major online services are also likely to experiment with the form and delivery of traditional database services, and the author expects them to unveil in the next year or so new products that attempt to change the face of electronic full-text. (Source: *Database*, 17(6) December 1994)

Industrial electrochemistry

Second edition. Derek Pletcher & Frank C. Walsh. London, Chapman & Hall 1993. Pp viii + 653. £19.95. ISBN 07514 0148X.

Here is an opportunity to obtain one of the most comprehensive treatments of fundamental and applied aspects of electrochemistry at a real value for money price. This softbound volume is a must for most industrialists and academics working in the field. It is an expanded version of the first edition (1982) and achieves quality coverage of the diverse areas encompassing electrochemical technology.

The book consists of 12 chapters: two introductory chapters covering the fundamentals of electrochemistry and electrochemical engineering, and 10 describing specific electrochemical areas. The first two chapters provide a solid foundation for an appreciation of the technology and engineering of the wide range of processes.

Industrial Electrochemistry is indeed a welcome addition to the literature, in a subject area which has changed radically in recent years.

Daily Telegraph launches Internet newspaper

The Daily Telegraph has become the first British newspaper to establish a strong Internet presence. Its Electronic Telegraph experiment offers a significant amount of actual content and is more than just a promotional vehicle. It is only available as a World Wide Web (WWW) service, accessible to people with full Internet access and a browser such as Mosaic or Netscape.

The Electronic Telegraph costs nothing to access. This will be reviewed in July. The review will be closely linked to the results of an advertising experiment that the ET will run in the first six months of 1995. It is already selling advertising space (advertisers include the Innovations catalogue company, Apple, and Sun Microsystems) and has received a lot of interest from the advertising industry. It also plans to announce deals with six advertising agencies where each will rent space in the ET and can then use this as they wish: agencies may resell the space to clients, or may provide it free of charge to stimulate business.

The basic news content is the same as the printed paper, but some of the smaller stories are omitted and even major stories are edited to a maximum of 400 words. Because of the predominantly younger male readership, the sports information has been heavily used and the editorial team gives this area particular attention. Some content is enhanced, in particular extra computer stories are carried in the Electronic Telegraph to appeal to the technically-aware population that reads it. Wire stories are not used in the ET, as existing agreements with the wire services do not permit this.

Internet publishing practicalities (Cyberleaf's "white paper")

This article takes a long look at a recent White Paper produced by Cyberleaf. While access to the material placed on the Internet may be just about free, preparing that material is not. Neither is maintaining the information. There are four key issues: the material created for distribution on paper inevitably looks bad when distributed electronically: the fonts are wrong, the information is not correctly formatted for the computer screen, etc.; even once the information is formatted correctly, if it does not take advantage of the capabilities Internet delivery affords, such as hyperlinks, buttons, multimedia, it presents the organization in a bad light; the Internet material needs to be maintained as corporate information changes, and this can be as labour-intensive as creating it in the first place; and learning how to do the first three steps can be unnervingly expensive since it probably requires learning several new languages, including HTML.

Cyberleaf provides templates for Web home pages (the first screen seen when a user makes contact) together with an editor which enables these to be modified. Perhaps the most important selling point, however, is that when it is time to update a document distributed over the Internet, you can revise it using the original application (e.g. Word or WordPerfect) without breaking any of the links. When asked by the author/publisher to insert a link, Cyberleaf duly marks it up in HTML, but it also records in a separate

file where that link is in the structure of the original (say WordPerfect) document. This means that, if ever the Wordperfect document is re-edited, then Cyberleaf is able to update the HTML version with the link re-created in the right spot. (RD) (Source: *Electronic Documents*, 3(12) December 1994)

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Many readers may not know of the excellent selection of publications available from IT Publications, the publishing arm of Intermediate Technology. Below you will find a very small selection of the titles that are available, followed by a list of booksellers and stockists around the world where books may be ordered. IT Publications is based at 103-105 Southampton Row, London WC1B 4HH, UK from whom a catalogue of all their published books may be ordered.

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Intermediate Technology (ITDG) is one of the leading charities involved in the long-term relief of poverty in developing countries. Its aim is to locate and use technologies appropriate to the social, cultural, economic and environmental needs of communities throughout the world.

How to Run a Small Development Project by A "Geneva Group" will help the managers of development projects to design and manage their projects well, in particular by emphasizing the importance of forward planning. Covers both starting up and running projects, and working with Northern partner organizations. 44pp. 1986, (ITP), ISBN 0 946688 47 8, £5.95/US\$11.50, paperback.

Sustainable Industrial Development Introduced by Marilyn Carr. Successful, established AT projects: forestry in Swaziland, Kenyan stoves, micro-hydro in Nepal, boats and cement plants in India, industries in Ghana and small grain production in Botswana and Zimbabwe. Can the benefits be sustained beyond the project? 208pp. 1988, (ITP) ISBN 0 946688 89 3, £10.95, paperback.

Appropriate Technology for Rural Development: The ITDG experience (Occ. Paper No. 2) by Derek Miles. Originally prepared for an Expert Meeting organized by UNESCO in 1980, this paper outlines Intermediate Technology's basic approach to development work; and assesses the lessons learned from 15 years experience in development activities. 32 pp. 1982, (ITP), £5.95/US\$11.50, paperback.

The Economics of Small—Appropriate technology in a changing world by Raphael Kaplinsky. Describes the origins and development of the appropriate technology movement, and analyses both its changing concerns at the different stages of development, and also its abiding emphasis on scale and human values. 244pp. 1990, (ITP), ISBN 1 85339 072 0, £25.00/US\$47.50, hardback. ISBN 1 85339 071 2, £9.95/US\$18.95, paperback.

The Management of Technological Change. An annotated bibliography Donnacadh Hurley with an introduction by Matthew S. Gamser. This extensively annotated collection of titles aims to guide Governments and other decision makers in developing nations in the choices they make in technologies, and also in the development of mechanisms

by which these selections can be implemented. 216 pp., 1987 (ITP/Commonwealth Secretariat). ISBN 0946688 842. £9.95/US\$18.95, paperback.

Mobilizing Appropriate Technology: Papers on planning aid programmes Edited by Matthew S. Gamser and others. Discusses the role of AT in a national aid programme. If AT enters the project cycle at too late a stage it has little influence over the technological choice and the grassroots organizations that play a key role in development and change in rural areas. 112pp. 1988, (ITP). ISBN 1 85339 045 3, £12.95/US\$24.95, paperback.

The Other Policy: The influence of policies on technology choice and small enterprise development Edited by Ton de Wilde with Henk Thomas and Frances Stewart. Foreign aid to developing countries often favours inappropriate technologies. This book reviews the policies promoting appropriate technology and identifies positive programmes of action that could be instituted at a national level. 512pp. 1990, (ITP). ISBN 1 85339 063 1, £25.00/US\$47.50, hardback. ISBN 1 85339 059 3, £14.95/US\$28.95, paperback.

Science and Technology—Lessons for development policy Edited by Robert E. Evenson and Gustav Ranis. The success of the newly industrialized countries of S.E. Asia is a prime example of the role that science and technology can play in development strategies. This book aims to identify those policies which have proved to be workable in most situations. 392pp. 1990, (ITP). ISBN 1 85339 062 3, £19.95, paperback.

Science, Technology and Development by Atul Wad. The author of this interdisciplinary book stresses that a full understanding of the introduction of new technology in all its aspects is the only way to achieve a workable compromise regarding science, technology and development. 316pp. 1989, (ITP), ISBN 1 85339 075 5, £19.95, paperback.

The Technological Transformation of Rural India by A.K.N. Reddy and A.S. Bhalla. The economic development of developing countries is hindered, in no small measure, by their technological backwardness and their lack of indigenous technological capabilities to master the absorption of new technologies. Despite the efforts made in recent years to study the technological transformation of developing countries in the process of their industrialization and growth, very little, if any, evidence exists of the nature and extent of the technological transformation of rural areas, which are generally bypassed by the advances of science and technology.

This book presents conceptual model of the process of commercialization of rural technologies in developing countries and then tests this model against some case studies taken from India's experience, concluding that India has placed far more emphasis on the survival of small-scale production units than on ensuring their efficiency and growth in a competitive environment. 192pp. 1994, (ITP). ISBN 1 85339 199 9, £14.95, paperback.

Technology Choice: A critique of the appropriate technology movement by Kelvin W. Willoughby. A comprehensive review and critique of the theory of appropriate technology, which proposes a framework for integrating traditional economic development with its techniques—a sober look at the obstacles, and an appreciation of AT's value. 350 pp. 1990, (ITP), ISBN 1 85339 057 7, £14.95, paperback.

Technology Transfer: Nine case studies by Sosthenes Buatsi. Nine case studies in technology transfer which demonstrate the experience gained in different countries and different technologies. 32pp. 1988. (ITP). ISBN 0 946688 29 X. £5.95/US\$11.50, paperback.

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New Zealand: Smail Resources International, Okari Road, RD2 Westport.

New Zealand: One World Books, P.O. Box 68-419, Auckland.

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Spain: Ecoserveis, Ceramica 38, 08035 Barcelona.

Sri Lanka: Lake House Bookshop, Sir Chittampalam A Gardiner Mawatha, P.O. Box 244, Colombo 2.

Switzerland: SKAT, Vadianstrasse 42, CH-9000, St Gallen.

USA: Women Ink, 777 UN Plaza, New York, NY 10017.

Zimbabwe: Grassroots Books, P.O. Box A267, Avondale, Harare.

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Machine Perception and AI Series—Vol. 17 Applications of AI, Machine Vision and Robotics edited by K.L. Boyer (Ohio State Univ.), L. Stark (Univ. of the Pacific) & H. Bunke (Univ. Bern). This text features a broad array of research efforts in computer vision including low level processing, perceptual organization, object recognition and active vision. The volume's nine papers specifically report on topics such as sensor confidence, low level feature extraction schemes, non-parametric multi-scale curve smoothing, integration of geometric and non-geometric attributes for object recognition, design criteria for a four degree-of-freedom robot head, a real-time vision system based on control of visual attention and a behaviour-based active eye vision system. The scope of the book provides an excellent sample of current concepts, examples and applications from multiple areas of computer vision.

Contents: Range Estimation from Camera Blur by Regularized Adaptive Identification (L-F. Holeva); Modeling Sensor Confidence for Sensor Integration Tasks (K. Hughes & N. Ranganathan); From 3-D Scattered Data to Geometric Signal Description: Invariant Stable Recovery of Straight Line Segments (P. Hebert et al.); Feature Extraction and Matching as Signal Detection (X-P. Hu & N. Ahuja); Non-Parametric Multi-Scale Curve Smoothing (P.L. Rosin); Integration of Geometric and Non-Geometric Attributes for Fast Object Recognition (L. Grewe & A. Kak); A Four Degree-of-Freedom Robot Head for Active Vision (F-L. Du & M. Brady); control of Eye and Arm Movements Using Active, Attentional Vision (P.A. Sandon); Behavior-Based Active Vision (C.S. Pinhanetz). 200pp. (approx.) 981-02-2150-9. Pub. date: Spring 1995. £33. Available from World Scientific Publishing Co., Farrer Road, P.O. Box 128, Singapore 9128.

Patterning of Material Layers in Submicron Region by U.S. Tandon and W.S. Khokle. Economic success of

multimegabit memories has upheld the evolution of technology for creating submicron structures. These structures also constitute neural networks, nanomachines, smart sensors, quantum devices and so on. *Patterning of Material Layers in Submicron Region* offers, in a single ensemble, state-of-the-art information on various lithographic and delineation techniques along with their applications. It invokes the interests of the reader into the wonderland of nano-miniaturization for industrial, biological and fundamental applications. Its contents portray the advent and relevance of submicron structures and proffer a perception of materials, modules and schemes for preparing them.

Patterning of Material Layers in Submicron Region puts forth a coherent and comprehensive treatise of three submicron patterning technologies viz. electron beam, ion beam and X-ray lithography. These technologies are undergoing rapid individual developments and are vying with each other to become the chief writing tool of multitrillion dollar microelectronic industry. This book is endowed with quantitative features of the operational ingredients such as sources, resists, masks, writing/aligning/scanning techniques and commercial/captive systems. It is profusely illustrated with layout diagrams, flowcharts, analyses and SEM pictures of novel results to ensure lucidity. The book also presents various recent developments such as X-ray mask preparation, plasma developing resists and compact synchrotron with statistical details.

Implications, scope and trend of these technologies are demonstrated through significant results followed by brief futuristic projections of the activities and devices. The book aims to meet the requirements of modernizing postgraduate syllabi and enhancing the capabilities of R&D engineers as well as capital equipment manufacturers. It also covers useful material for technology optimiser and device & systems planner. The book is published by Wiley Eastern Ltd., ISBN 81 224 0561 4 (1993), pp. 183.

Microelectronics State of the Art Report. Written with the specific purpose of elucidating different levels of

microelectronic technology, this book covers evolutionary, economic, implicational, social and human developmental aspects of microelectronics. The book begins with a chronological overview of the growth of semiconductor electronics since the mid-twentieth century. It attempts to familiarize the reader with the scope and fabrication aspects of logic and memory devices, hybrids and micromachined integrated sensors, etc. In the international arena, it offers a window to trendy materials and industrial applications of microelectronic devices, advanced fabrication techniques, neural and molecular electronics. It goes on to discuss interesting economic data, industrial linkages and techno-economic compulsions.

Activities in microelectronics education, R&D, pilot production and industries being pursued and planned in the member countries have been described in fair detail with relevant business data, etc. To meet the specific demands regulated by technology absorption levels of various countries, groups of specific technologies and their limitations have been dealt with in detail. These include multilayer PCBs, hybrid microcircuits and discrete and power semiconductor devices; fields of applications of all of them are systematically described. Design as well as fabrication process steps of linear, digital and special monolithic integrated circuits which account for about two thirds of all microelectronic devices have been explained in simple terms. Principles of state-of-the-art processes such as chip and system design, mask making and replication techniques, different material growth and modification processes, lithography, plasma etching, etc. have been explained lucidly. Glimpses of economic and social influences on humanity at large, resulting from the technological growth and applications of microelectronic devices and systems are given. Suitable plans with methodology and economic factors for setting up various levels of microelectronics centres are given as recommendations in the text. The book was prepared for the Centre for Science and Technology of the Non-Aligned and other Developing Countries (New Delhi) by Dr. W.S. Khokle and Dr. U.S. Tandon, pp. 100, US\$25.

