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MICROELECTRONICS MONITOR

Vol. 2, No.3, 1995

CONTENTS

SPECIAL ARTICLE

Software Production in Developing Countries: The latent capability of small software houses

by Wilmer Hernandez Vargas

NEWS AND EVENTS

NEW DEVELOPMENTS

MARKET TRENDS AND COMPANY NEWS

APPLICATIONS

SOFTWARE

COUNTRY NEWS

AUTOMATION

STANDARDIZATION & LEGISLATION

RECENT PUBLICATIONS

UNIDO's *Microelectronics Monitor* is established as a mechanism of current awareness to monitor developments in the microelectronics sector and inform governments, industry and academia, primarily in developing countries

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TO OUR READERS

UNIDO's observations in the field of small software producers in developing countries confirm that the situation has changed dramatically in the last years. Techno-economic changes on the world market have created a new situation qualitatively, which offers new opportunities as well as closing some niches from which small producers used to benefit.

As a result, and after deliberations within our editorial team, we are introducing a discussion on the new state with the paper by Mr. Wilmer Hernandez Vargas, entitled *Software Production in Developing Countries: the latent capability of small software houses*.

Software producers willing to share their views with UNIDO on the new development are invited to submit their opinions to us. Some of the contributions may be published in the **Microelectronics Monitor**.

Software is only one component of a dramatic change in the whole sector of information technology. The change is presented in the last issue of **ATAS Bulletin** published by UNCTAD. The Advance Technology Assessment System (ATAS) was initiated in 1984 as a vehicle for strengthening the endogenous capacity of developing countries by means of technology assessment. Previous issues of the **ATAS Bulletin** covered such subjects as tissue culture, automation, materials technology, energy technology and photovoltaics.

Almost a decade ago, the **ATAS Bulletin** covered new information technologies for development. Advances in IT since then have been so rapid and their impact so pervasive that the issues are ripe for review. These developments are reshaping the global economy by their effect on information processing, productivity and competitiveness. Minaturization, new and powerful software and lower prices have contributed to the rapid diffusion and use of information technologies, mostly in the developed countries and the newly industrializing countries. In developing countries the diffusion process was been rather slower, more than likely due to lack of IT strategies and policies, low levels of personnel, lack of supporting infrastructure, lack of investments, and the inability to keep pace with rapidly changing technologies. For the economies in transition, the problems appear to be more concerned with the need to improve and redeploy telecommunications and current IT infrastructure, including resources from military to civilian use.

The above mentioned issue of the **ATAS Bulletin**, which I recommend to readers of the **Microelectronics Monitor**, contains several papers prepared for UNIDO by consulting specialists cooperating with UNIDO in the scope of the Consultative Group on Information Technology for Development, namely Messrs. Kopetz, Mandl, Correa and Softysinsky, and who have for many years given their assistance to the Organization in its technical assistance programmes.

As mentioned in an earlier issue of the **Microelectronics Monitor**, UNIDO is now accessible on the World Wide Web. In the present issue we describe in more detail what sort of information may be obtained at present and how to go about accessing it. Later on during 1996 we hope to be able to make considerably more information available through the WWW. We will keep readers informed.

Konrad Fialkowski
Scientific Editor

CONTENTS

	<i>Page</i>		<i>Page</i>
A. SPECIAL ARTICLE	1	Sharp develops 1 Mb ferroelectric memory ..	16
SOFTWARE PRODUCTION IN DEVELOPING COUNTRIES: THE LATENT CAPABILITY OF SMALL SOFTWARE HOUSES	1	Breakthrough in thin film resistor	16
Introduction	1	Industry's first 128-bit graphics accelerator ..	16
Absorption capability and development potential of software houses	1	Storage in quartz	16
Weaknesses and strengths of developing countries	2	Natural born cells	16
Strengths	2	Solar eclipse	17
Principal needs of small software houses in developing countries	2	Gallium arsenide joins the giants	18
Market trends	3	German researchers study superhard thin films	19
The major IT challenges	3	NEC develops observation semiconductor laser	19
Software production by the end of the 'nineties and attractive markets for small software houses in developing countries ..	4	Mitsubishi materials develops new method for producing 8-inch wafers	19
Competing with large software companies ..	5	Fujitsu develops dry-washing technology for silicon epitaxy	20
Final recommendations	5	Toshiba creates single electron tunnel transistor	20
B. NEWS AND EVENTS	7	Team develops energy recycling LSI element	20
UNIDO on the World Wide Web	7	Sanyo develops decoder chip for world's first eight-speed CD-ROM	20
Efficient and convenient information dissemination	7	Research establishment develops silicon nitride fibre using radiation	20
Getting the right message to the right person	7	Mitsubishi develops DVD system with 135-minute capacity	20
Plans for the future	8	World record stationary magnetic field using 40 tesla hybrid magnet	21
Should information be free?	11	Rechargeable lithium battery	21
Crime on the Net	11	New material for touch screens	21
Changing contexts of communication (electric writing)	11	Osaka National Research Institute develops titanium nitride ultra-thin conductive film ..	21
Network security	11	Blue light emission from GaN LED	22
Independent information brokering	12	Low-g accelerometer introduced by Analog ..	22
Ensuring universal access to the information superhighway	12	Low temperature, low pressure diamond thin film synthesis	22
Library services: free or fee?	12	Manufacture of ferroelectric material	22
Policing the Net	12	LCVD used in rapid prototyping of complex lattices	22
Publishing databases on the Internet	12	New printed circuit wafer for low-cost multi-chip modules	23
Staff perceptions of incentives and hurdles in the use of technology	13	Tantalum nitride barrier material for copper printed circuits	23
The enterprise as a knowledge economy	13	Single electron transistor	23
Strategic information systems planning	13	Power consumption of CMOS circuit halved	23
Job creation in the information society	13	World's first successful electricity transmission test using high Tc superconductor ..	24
The role of traditional social science information providers within the Internet community	14	New type of micro frictional force measurement system	24
Internet insights: how academics are using the Internet	14	Super high-density magneto-optical disk ..	24
C. NEW DEVELOPMENTS	15	High-performance frame buffer memory for three-dimensional graphics	24
Superhigh-speed, long-distance transmission by optical fibre soliton	15	Magnetic microcapsule display sheet	25
Nanotechnology	15	Roll-up reflection-type polarized screen for liquid crystal projectors	25
Wirebonding through film with plasma deposited silicon nitride	15	CNR produces high energy, less polluting batteries	25
Simple full-colour LEDs	15	Mini alternative for picture tubes	25
		Low-power consumption colour TFT LCD ..	25
		Three types of optical control FETs	26

CONTENTS (continued)

	Page		Page
D. MARKET TRENDS AND COMPANY NEWS	27	Setting up a World Wide Web site	37
Market Trends	27	Lab test: Network administration software ..	37
Annual forecast for fab materials	27	The use of industry standard software	37
Optical disc drive growth	27	Getting the picture on image databases: the basics	37
Equipment benefits from chip demand	27	Geographic information systems: an information management tool	38
Silicon producers achieve record sales for 1994	27	The model Information Marketplace	38
Samsung sales hit billion dollar mark	28	New Internet software	38
Russia, Eastern European semiconductor industries now viewed as devastated	28	Software distribution via the Internet	38
Company News	28	The word processor is ticking	39
Fujitsu strengthens marketing of AP1000 parallel supercomputer	28	G. COUNTRY NEWS	40
NEC establishes parallel processing supercomputer centre	28	China	40
Canon to increase stepper production	29	Fibre-optic cable links cross China	40
Sales soar in Europe's big three chip firms ..	29	IBM, Shanghai Jiaotong University jointly build Asia's first full-function computer network	40
Electronics recycling	29	A web for the masses	40
Shin-Etsu Handotai to boost output in the USA	29	New development modes	40
E. APPLICATIONS	30	Tianjin University develops controllable piezoelectric motor	41
Supersensitive metal defect probe system using superconducting magnetic sensor	30	I-Micron integrated circuit developed by Huajing Group	41
Graphic traffic	30	France	41
Optical pointing system for PC-based presentations	30	France Telecom to invest in information superhighway experimentation	41
Compact, lightweight digital still camera ..	30	Israel	42
Highest resolution infrared ray CCD camera ..	31	Jerusalem University builds parallel computer ..	42
Low-cost PLCs	31	Italy	42
Exerciser plugs holes in PCI system development	31	Researchers announce revolutionary hard-disk access system	42
Micromachining applications in the auto industry	31	Singapore	42
Navigation for cars	32	Information technology enables business process re-engineering at YCH DistriPark	42
Telephone voice recognition and response system	32	United Kingdom	42
Image recognition system using artificial retina chips	32	IT purchasing problems	42
Use of information technology by biological researchers	33	H. AUTOMATION	43
Intel core serves I/O solutions	33	Crane crash avoidance sensor (micro-robot) ..	43
UK system points finger at thieves	33	Automated preprinting plate CAD system for textile printing	43
F. SOFTWARE	34	I. STANDARDIZATION AND LEGISLATION ..	44
Europeans can capitalize on US shortfall ...	34	Standardization	44
Low-cost robot simulation software	34	Competing high density CD standards	44
Fujitsu develops faster CAD software	34	NIST standard for excimer laser energy	44
Imaging tool extracts forms	34	Legislation	44
DADiSP now does neural nets	34	The digital world and intellectual property ..	44
European Software Quality Initiative	35	What price patent information? (EPO/INPI Questel dispute)	44
A new text compression technique based on language structure	35	Internet encryption ban "violates free speech" (US court action)	45
Catriona: netting the cat and PACing the Net ..	35	J. RECENT PUBLICATIONS	46
Client/server computing	36	Patent information on disk	46
All wired up with no place to go	36	Chemical Abstracts on CD-ROM in 1996 ...	46
Individual's big Web experiment (NewsPage) ..	36		

A. SPECIAL ARTICLE

SOFTWARE PRODUCTION IN DEVELOPING COUNTRIES: THE LATENT CAPABILITY OF SMALL SOFTWARE HOUSES

by *Wilmer G. Hernandez Vargas*
(Costa Rica)

Contents

Introduction
Absorption capability and development potential of software houses
Weaknesses and strengths of developing countries
Strengths
Principal needs of small software houses in developing countries
Market trends
The major IT challenges
Software production by the end of the nineties and attractive markets for small software houses in developing countries
Competing with large software companies
Final recommendations
Notes

Introduction

Software production in developing countries is usually an underdeveloped and poorly promoted activity, yet we know this is not through lack of capacity or the technological level of their populations. It is well-known that the potential and capacity of software houses in developing countries are not only amazing, but that the development and promotion of such an activity is highly promising, and indeed very profitable as well.

It is debatable whether one should dwell only on small software houses in developing countries, or whether to start taking into consideration the small systems integrators' houses as well. This is due mainly to the fact that the operating environment has changed very rapidly. A few years ago most of the small software houses were able to survive and get by with the development of software products that were appropriate for day-to-day needs, such as accounting and administrative systems, but today, almost all day-to-day needs can be satisfied by off-the-shelf, low cost, mass market products. This represents a shift in the operating conditions for those small software houses in developing countries, and should be a signal to developing promotional organizations, regarding the focus of efforts in the near future.

These and other topics are approached in this article. It is the author's hope that the article will serve to enlighten some people involved not only in activities concerning general policies for the promotion of software development houses in developing countries, but also those actively associated with the implementation of projects dealing with technology promotion in developing countries. The article will also feed those small software houses in developing countries with some guidelines and technology trends in this dynamic market.

Emphasis is placed on the fact that the recommendations presented in this document are valid for

products and services to be sold between 1996 and 1999. After 1999, some environment variables may have changed to such a degree that new issues may have to be considered. We are now in a time of quick and aggressive change.

Absorption capability and development potential of software houses

When we talk about the technology absorption capability of small software houses in developing countries, the situation usually turns out to be quite impressive. This is because software houses are very conscious of the need to be up-to-date on the latest tools and resources. After all, they face changes every day, and change assimilation is supposed to be part of their activities. In fact, software houses are very prone to accepting new technology and new business processes. We have noticed that some of the reasons why software houses in developing countries have such a strong absorption capability of new technology, can be directly related to:

1. The cultural and technological inclination of the people managing and working in those software houses.
2. The structural and management body is small, flat and low on bureaucracy, so decision making is quick and usually very proactive.
3. The age and technical skills of the people working in software houses (they are usually young, dynamic professionals) make them easily adaptable to accept and live with environmental change.
4. In general, change can be carried out by updating some software tools and special training. Usually there is no need to move out a lot of equipment and staff, which means that absorption can be carried out almost painlessly and with a low economic impact.
5. The highly dynamic nature of the business itself.

Obviously, given all these conditions it seems clear that software houses have a lot of strategic and cultural strengths, especially for the management and development of technology-based products. Furthermore, the potential has been barely conceived. However, this potential has already been spotted by some large software house from developed countries. Companies the size of Novell, for example, have some production facilities in India, while Borland and others are undergoing subcontracting activities in some of the countries of the former Soviet Union. Unfortunately, it has to be made clear that, due to marketing reasons, most of the information related with this type of "deal," and licensing of technology, is not always publicly recognized. We expect this to change some time in the near future. Then there will be no reason to hide the fact that some of the technology sold in developed countries is being created and developed in small software houses in developing countries.

Weaknesses and strengths of developing countries

The weaknesses of software houses in developing countries come in different shapes, sizes and colours. Some are related to technology policies and administration, some to geographical locations, some are just plain cultural and circumstantial; and even present market pricing—economic issues sometimes play a very important role.

We will list the weaknesses in order of importance, beginning with the one we consider to be of prime importance, especially for small software houses, and for the institutions involved in support and technology promotion.

1. Lack of information and awareness of market trends, technology trends, the direction of the large economic clusters, and some economic and political tendencies, the globalization of economies and the rate at which the change is taking place. Of course, this will affect not only software houses, but all types of businesses will be affected as well, and this could have a direct and deadly impact on businesses that have technology as a core activity.
2. Out-of-sight financing facilities, poor marketing and lack of information about the process itself. Amazingly, there is usually money to do research and development of new products, but no venture capital or provision for selling the results. There is even no provision for money for after sales support.
3. There are few sources of information on what is on the market, what the current prices are, user needs, trends and tracking of buying patterns.
4. Untimely design and development of products and services.
5. Poor access to information on new manufacturing technologies and process.
6. Lack of outsourcing possibilities and networks of electronic product/data interchange.
7. There is a lack of data for market segmentation, massive marketing campaigns and competitiveness.
8. Networks of probable co-investors, co-developers, dealers and distributors' channels are not available. Information to hand tells the tale of a very small software house that created a technology so advanced, that the four largest software companies in the world estimated a gap of between one and five years in their own capability before they would be able to begin working on that particular level of technology. The sad part is that this small developing country software house spent almost a year and a half trying to get some executives from the large software houses just to look at the technology. There is also the tale of another small software house which developed a Spanish language one million entry dictionary to fit onto one floppy disk, and which could never get anyone with decision-making authority to look at it. Today, both companies are trying to go it alone.
9. Most of the time, small software houses are managed by technical/scientific people. There is little feeling for business management of the nineties, and we end up with products out of sync with the users' needs and market trends.
10. Poor awareness of what is being promoted, i.e. product innovation, new product development, ISO 9000, TQC (total quality management), etc. and what is needed. We do not see many consultants and development institutions saying ... "get your product developed and then talk to us, we have the connections to help you

put your services and product into the customers' hands." Neither do we see development promotion institutions saying ... "do not get involved in product development without first making sure you know what the needs of your customers are" That is an invitation to failure.

11. Lack of a critical mass of customers for their products. Mass market products locally focused are not usually profitable.

Before, access to the latest technologies could be claimed to be a limitation, and indeed the latest technology prices, but today this is no longer a restriction. Small businesses in developing countries can easily grasp almost any type of technology, and because of market trends, prices are lower than ever.

Strengths

From the most important to the least, the following list shows some of the main strengths of software houses in developing countries.

1. One of the quickest capabilities of adapting to market trends, without investing a lot of money on the transition process, and without this having a strong impact on the production and process facilities.
2. The switch to new technology is usually very inexpensive. Just consider that small software houses work with limited equipment and human resources, so there are few tools to upgrade, and the training investment is limited. (Picture the switching cost to a new technology if the software houses have more than two hundred programmers working on a word processor).
3. The decision-making process is usually based on a flat structural organization, so there is little bureaucracy to deal with.
4. There is a limitless potential regarding the absorption of technology, and usually this absorption capability is only bound by the possibility of obtaining some commercial use of the technology in the short or medium term.
5. Due to their environment, small software houses frequently deal with wide ranging limitations and constraints, they are more receptive to change and accept new ways of doing things.
6. **Niche orientation:** small software houses are being pushed into change by their closest customers, usually a lot of small businesses with diverse necessities and timings, therefore small software houses usually become very proactive. Large software houses, however, move according to the momentum of large enterprises and global trends.

Principal needs of small software houses in developing countries

Once people have an idea of the strengths and weaknesses of small software houses in developing countries it seems easy to decide on what are their needs. But this is not that easy. Software houses and countries are so different from one another that at times it appears to be an impossible feat. But there are some general rules that may apply to a vast majority of cases. In the near future software houses in developing countries will demand:

1. All the information they can get to keep abreast of the latest trends in hardware and software. Whether the Internet or some other media is used will make little

difference, the main point will be to get the information no matter what.

2. Up-to-date training on marketing of technology-based products and services, on customer satisfaction and searches for new opportunities and business.
3. Training on how to manage technology-based businesses, co-investment, joint ventures, technology transfer, product innovation, etc.
4. Up-to-date training on technology for networks and electronic data interchange systems.
5. Support on how to set up a network of businesses for the interchange of technology with companies from developed countries. A network of technology and services requests from developed countries, and a network of providers from developing ones are urgently needed.
6. Last, but no less important, financing resources to help market products and services. A network of joint venture institutions, venture capital institutions, etc. from developed countries for companies in developing ones may also be considered useful.

Market trends

At the end of the 1970's, the role of small and large software houses in most developed countries was just to support the automation of some basic business operations. In fact, everything was almost product- and process-oriented (software products were considered a rare and specialized tool); mainframes and the concept of time-sharing were sovereign. During the 'eighties and at the beginning of the 'nineties, software houses found that there was a lot of money to be made just developing bulk market products for day-to-day operations, focusing on products that fill generic needs; and so, we find the word processors, electronic spreadsheet, personal database managers, etc., turning into products to be acquired in the supermarkets. (*And software became a commodity*).

Nowadays, large software houses fill the supermarket shelves with lots of software products for almost any need a business may have, and at prices that are hard to resist, not only in developed countries, but also in developing ones. The choice is so vast that it is difficult to think about something that has not already been developed.

In some developing countries, when looking at the installed base of microcomputers, it seems as if they will retain a low level 286/386 platform for a while, but we believe this will change faster than it appears, not because 286/386s are not being manufactured any longer, but because of the different alternatives developing countries have today. 486s are being sold at the same price as a 386, and a Pentium microcomputer can be obtained for the same price as a 486.

This is the trend we must consider, and the rates at which this is taking place, together with the fact that some developing countries only have a low-level platform, only shows where they were allowed to arrive at before, and not where they going to be in the near future.

In order to speak of today's market trends, we must first withdraw a little bit from just the software side of the equation, and take a look at the other side of the coin. To talk about market trends we must consider why those trends are being generated, otherwise efforts may become worthless, especially in developing countries.

We know that the tip of the trends belongs to the market's forerunners, and whatever is between the tip and the next trend, belongs to whoever may get there *on time*.

So let us take a look at that other side of the coin, where we find the new challenges organizations will face in the coming years.

The major IT challenges

The major issues organizations will be facing in the next few years are very clear, at least for most of the companies that participated in a study made by CIO COMMUNICATIONS INC.¹ The study was so well prepared, that the end results seem to cope with the challenges of not only developed countries, but are also valid for developing ones as well. Let us take a look at them.

1. **Access to Information:** never will information be more important for companies than in the next few years. The Internet—the mother of all networks—will become the commercial highway of choice, just because it will allow access to information from anywhere to everywhere. Competitive companies will require timely access to the key information for their businesses, no matter where that information may be, or how it is coming. Without doubt, Internet will be one of the most influential elements in this race to access information. In February 1995, estimates were made that more than a million Web users keep accessing more than 27,000 Web servers throughout the world. During 1994 the number of Web servers doubled every two months. Today, 500 new Web servers appear on the Internet every day.² It is hard to imagine how this is going to end and how it is going to affect developed and developing countries.
2. **Client/server or distributed systems:** companies should decide whether to maintain obsolete information technology tools, or whether to move to client/server or distributed systems. Obviously, the decision will mean a lot of investment, retraining, new products and services.
3. **Service delivery issues:** companies will have to find the most efficient, economic and practical ways of delivering their services. Most likely, the delivery of these services will have to be dressed up in some high-tech clothes, such as multimedia, virtual reality, holography, and others.
4. **Globalization:** at the rate this trend is taking place, almost every company in the world will be facing at least the side effects of globalization before the end of this century. Companies and non-governmental organizations should prepare to deal with this key issue, whether they like it or not.
5. **Information Technology alignment with Business Strategy:** information technology will finally have to play the role for which it was intended, i.e. the empowerment of business strategy. The automation of business processes now becomes a side effect.
6. **Change management:** companies must be prepared to change, to change the way management is carried out, to change old fashioned uncompetitive business methods with new and more astute strategies. This will probably be one of the most frequent reasons for companies in developing countries to fold up, as there are many companies in such countries that are still managed according to the way that grandfather used to.
7. **Information infrastructure:** counting on the best possible infrastructure will be a key factor, especially since some of the challenges can only be faced with an

adequate supporting information base. This will impact not only companies, but Governments and countries alike.

8. **Business process re-engineering (BPR):** BPR is knocking at the doors of almost any business that wants to be competitive in the next few years. Sometimes the process will itself enter the business through the back door, and the impact will be amazing. Most amazing of all will be the amount of businesses that will fail by just getting into BPR on the wrong foot at the wrong time.
9. **Cost containment:** due to the new ways of accessing information sharing, the globalization process and other trends, it is a good moment to go back to the "savvy game" of cost containment. Figures should be revised to guarantee that we are making the money we need by these products, and to guarantee that we are not losing it in some other services. The competition will be so fiery that some companies will be counting pennies to keep competitive.
10. **Human resources issues:** to retain and keep well-trained people will be crucial, as there will be less time for on-the-job training, and the training itself will be more expensive. New ways of encouraging and motivating workers will have to be devised. Indeed, some companies from developed countries are already considering the effect of this in advance, by taking 15 per cent of the time the workers are supposed to work, and diverting this time to send staff back to school for specialized training.
11. The Meta Group estimates that companies will waste the equivalent of two to five monthly salaries a year,¹ by not giving formal training to users and staff. At least for the next five years, the management cost will overshadow any other cost savings made on hardware or software. More than ever, keeping good people where they belong is crucial.
12. **Ideas for using technology:** technology is spreading everywhere, getting into the most recondite places as communications devices, medical instruments, computers and automation equipment. None the less, there are about 70 per cent of devices and gadgets that have yet to meet with the new technologies. The most recent cars, for example, come with less than 5 per cent of electronic equipment integration; most of the components are just electric and mechanical, and the micro-electronics technology is unknown. So there are a lot of new devices, adaptations and implementations involving the new technologies. There is a huge market waiting out there. Companies *need to find creative ways of packing technology*, and delivering new service bases for user needs. This is one of the most delicate challenges, especially since everyone has access to almost the same technology, and the difference will be made by the way each company manages to differentiate its products from those of other competitors.
13. **Maintaining legacy systems:** this term is related to the information technology used during the last two decades. The challenge faced here is how to justify the continuance of those systems, i.e. poor old mainframes, minis and proprietary equipment, especially when comparing them to the new low cost/high performance open systems alternatives that are more prepared to cope with modern, changing times.

These are some of the major issues companies will be facing in the coming years. Large software developers are beginning to react with alternatives to these issues, and of course at the beginning the alternatives, most of the time, are only in the hands of large software houses in developed countries. However, some hope still remains for small software houses in developing countries.

Now, let us look at the other side of the coin, at how these issues affect the trends of software houses in developing countries.

Software production by the end of the 'nineties and attractive markets for small software houses in developing countries

There will be some areas that cannot be easily handled by large software houses, because of production scales, due to return on investment (ROI), and sometimes just because of time constraints. This will leave some very profitable niches for small software houses in developing countries.

At this point it is very important to first of all emphasize where small software houses *should not waste their time, efforts and resources*. Small software houses in developing countries should move away from:

Office automation: operational financing and budgets, marketing, workflow data processing, word-processing, E-mail, document management, desktop publications and graphics applications.

Plant and process automation: manufacturing and process support systems (manufacturing resource planning (MRPII/CAD-CAM), flexible manufacturing systems (FMS), robotics, statistical quality control (SQC), and others, electronic data interchange and subcontracting (EDI)).

This means that it makes no commercial sense to have or patronize a small software house in a developing country for the development of a new electronic spreadsheet, a new accounting system, or a new word processor. There are plenty of these products on the market, and if they are not yet being sold in some developing countries, they soon will be.

We would like to point out that developing countries are the next target for large software houses, especially for massive sales of their products. Language will not be a barrier, nor price, or competition. The next release of Windows 95 will be sold in *more than 25 languages for less than US\$ 200*—just consider the effect this will have in two or three years' time!

Obviously, for small software houses in developing countries, *there is no money to be made* here. So the question arises of what type of software should be developed? The answer is not easy, or precise. But there should be a wide area for a whole new string of products dealing with the smart/innovative use and implementation of products related to:

The area of office automation/plant and process automation: the *integration/deployment* of whatever is being sold on the market to fit the particular needs of small businesses, and here we mean customization, tailor-made services, etc.

Technology management and R&D: New technology applications. Information and market research. Software to facilitate the development of new products. Computer simulations. New uses of finite elements analysis (FEA). Innovative applications for GIS (geographical information systems). Parts and components technology (reduction of

parts and synthesis of components). Automated warehouse management and virtual manufacturing. Strategic use of technology. Re-engineering support systems and tools for technology transfer.

Management: Management information systems (MIS). Decision support systems and groupware. Electronic conferencing. Environment and risk assessment under different circumstances. Project feasibility. Strategic/tactics planning support. Co-investment/finance and joint-ventures. Business networks systems.

Didactic software: this is an area where large software houses will take some time to tackle, especially due to cultural barriers and customs. Local software houses are familiar with their people and their environment. Almost all the teaching that was once done by hand, should in some way be quickly turned into an electronic medium. The old concept of teaching is being changed little by little by the different digital alternatives. Just imagine how many courses of *Mechanics 101* or *Physics 305* could be prepared using electronic tools, and there is almost no one working on this type of product.

System integration, office automation and network design: as the proliferation of standards on databases, and systems from different vendors appear everywhere, it becomes important to have all those systems talking to each other and delivering information to decision-makers. The chances of making money with the integration of those systems, and doing some fit-to-specs products are wide and open. Apart from that, due to the significant role that networks are beginning to play everywhere, designing, installing and maintaining those networks also becomes a very profitable business. Let us make the electronic spreadsheet talk to the client/server database, and let us ask the same tool to track the amount of product coming out of the production line—and make some real-time graphics of the process.

Computer telephony: This is a market that will reach US\$ one billion before 1999.⁴ It comprises two technologies born to work and live together: the computer and the telephone. Sooner or later we will start seeing these two commodities merging into one.

Internet: Internet-related business will mean a lot of money on almost all fronts: more than US\$ 4 billion annually by the year 2000.⁵ The following list shows some projections:

1. Just for the access time to Internet: \$4,209
2. Software for services and products based on Internet: \$2,823
3. Hardware to access Internet: \$2,244
4. Complementary services to Internet: \$1,581

Competing with large software companies

In the technology business, when there are small and large players facing each other, the best way for the small party to compete is by not standing in a place where the large one can tread on it. Today, this is more than true, especially when the few leaders of the software business are consolidating their businesses, thereby becoming stronger than ever. Novell took part of Borland, Soft-Solution and WordPerfect; IBM is now the owner of Lotus; AskSan and Clipper now belong to CA-Associates and Microsoft is buying anything it can and Uncle Sam permits.

A few years ago, large software companies were not becoming involved with developing countries. By the end of 1996 we are going to see that trend change. More of them will be everywhere in the world, not only because of

the globalization process, but also because of the need for them to create more new customers, and that is the potential of developing countries. During the last decade, the developing countries was where one went to for low wages and cheap natural resources; today, and tomorrow, developing countries are where one finds new customers and where one goes to widen up the markets. This is very clear. Nowadays, the term developed countries means they only upgrade their own products, whereas developing countries means new customers, new services, and a diversity of opportunities.

In June 1995,⁶ Microsoft Office had an installed base of more than 7 million copies. There is little chance of taking some of those licenses away at the snap of a finger, therefore it makes no sense to consider developing products that are included within Microsoft Office, or any other office package for that matter. Instead, it makes a lot more sense for small software businesses in developing countries to learn how to better use the tools included in Office so as to fulfil the needs of local customers, or to come up with solutions for client needs that no one is developing, or paying attention to.

Thus, for small software houses in developing countries, the best way to compete with large software houses is not to compete against them, but to use their products as a basis for system integration services. They may even have the opportunity of doing this through the use of a worldwide network of associates and consultants supported by the payment of an annual fee. In exchange for the fee the consultants gain access to the latest products and services in advance—Microsoft Developer Network, and WordPerfect Perfect Fit Partners are two of the options.

Using this approach will allow small software houses to use their energies on that part of the services which are really value-added, and not to redevelop source code or deal with basic issues of software.

Small software houses in developing countries should draw close to the market leaders who are involved in the most promising technologies, such as:

1. Operating systems such as Windows 95, Windows NT, and NetWare
2. Computer telephone applications
3. Image and document management
4. Telecommunications and networks
5. Education software and leisure applications
6. Consultancy services on industrial and commercial automation.

Development institutions should seek to obtain the kind of help small software houses really need, as well as acquire strategic and tactical ways of keeping abreast of international trends, plus the development of networks of technology companies from developed countries interested in doing business with developing country companies.

Final recommendations

Software development in developing countries is a sound business, as long as it is based on actual customer needs and in tune with market trends. Money can be made on special niche products and systems integration services. Internet, education and computer telephony will become key technologies for almost everyone.

Small and large software houses in developing countries should keep in close contact so as to fulfil local needs as regards systems integration. Cooperation more than competition will make a lot of sense, and it will make a difference.

Technology promotion institutions should advise on imminent issues, on the direction of trends, and find ways of enticing networks of companies from developed countries to talk to those of developing ones.

The old paradigm of small software house promotion should be modified to include systems integration services and planning of new methods of disseminating necessary information to small companies by using Internet.

The developing countries must be encouraged to move forward, to be competitive in the market we will be facing two or three years from now, and not to aim for the type of competitiveness that prevailed in the market environment three or four years ago.

Policy makers should use past trends only as a reference for the future, not as a basis for developing and promoting. Let us promote development towards future environments and not according to past conditions.

Notes

1. Adapted from CIO, CIO COMMUNICATIONS INC., 1 March, 1995, p. 48.
2. OpenComputing, McGraw-Hill, USA, May 1995, p. 29.
3. Adapted from The Meta Group, OpenComputing, McGraw-Hill, USA, February 1994, p. 41.
4. Computer Telephony, Computer Telephone Publishing Inc., August, 1995, p. 64.
5. Source: FORRESTER RESEARCH, LAN Magazine, Miller Freeman Inc., USA, August 1995, p. 24.
6. LAN TIMES, McGraw-Hill, USA, 19 June, 1995, p. 41.

B. NEWS AND EVENTS

UNIDO on the World Wide Web

Looking for UNIDO information? You could save time and resources by checking the UNIDO World Wide Web server (<http://www.unido.org>) first (figure 1, The UNIDO homepage). This attractive, user-friendly information service allows users with an Internet connection and a "World Wide Web Browser" such as Netscape (TM) or Mosaic (TM)—to access UNIDO's growing collection of public information, services and information products with unprecedented convenience.

Efficient and convenient information dissemination

The World Wide Web revolution

In 1992, when the European Laboratory for Particle Physics (CERN) introduced the World Wide Web, the number of computers connected to the Internet (hosts) reached one million. The need to memorize a myriad of computer commands, codes and "internet addresses" had been alleviated somewhat by earlier developments such as Archie (Peter Deutsch, Alan Emtage, and Bili Heelan at McGill University, 1990) and Gopher (Paul Lindner and Mark P. McCahill from the University of Minnesota, 1991). With the advent of the World Wide Web, navigating the ever-growing international network of computerized public information resources was as simple as selecting highlighted text called "hypertext links". Information resources that were once the domain of a relatively small group of specialists, students and the technically ambitious were now within the reach of a growing, interdisciplinary "global information culture". By 1995, the number of Internet hosts had exceeded 6 million.

Hypertext and the URL

A key ingredient to the success of the World Wide Web is its use of the Hypertext Markup Language (HTML), which allows the location of a very specific item of information, anywhere on the Internet, to be pinpointed and presented to the user as a line of text. The location is specified with a "uniform resource locator (URL)", which looks something like: <http://www.unido.org/start/new/navigator.htmls> (or the What's New Page of the UNIDO WWW server). Using HTML, this URL can be linked to the words "What's New?" so that the user may jump to this "page" of information by simply selecting the phrase, "What's New?". On most computers, this is done with a "pointing device" (a "mouse", for example).

Efficient information dissemination

Using the WWW saves time and resources. Information can be published while it is still current, quickly and efficiently. For example, during the UNIDO General Conference in December 1995, press releases and a journal of each day's proceedings were published nightly and distributed to Member States, the international press and the general public. A marked increase in usage of the UNIDO WWW server was noted during this period and could be directly attributed to this activity.

The potential benefits to the environment are immediately obvious. Since the UNIDO WWW server was

opened to the public on 6 October 1995, over 222 million bytes of information have been transmitted. Given that the average size (including the UNIDO logo) of a document on the UNIDO WWW server is about 4.5 kilobytes per page, over 49,000 pages of information have been distributed by UNIDO without paper. Of course, many WWW documents are printed on paper after they have been received, but when one considers the number of copies of a published document that must be printed to reach 49,000 readers, these figures become even more compelling!

A structured, user-friendly approach

Every effort has been made to keep the UNIDO WWW server as clean and consistent as possible. An automated document management system, designed and executed especially for UNIDO, makes it possible to efficiently manage a steady flow of new submissions—since September 1995, with only two staff members working on the server full-time, over 200 documents have been published.

One big full-text database

From the very first menu, the user is presented with a hypertext "search button" which allows every document on the server to be located by words from its text (figure 2, The UNIDO WWW server's search facility).

Navigational aids

In the early stages of the UNIDO WWW server's design, a "corporate image" for UNIDO WWW documents was developed, which included such amenities as a "clickable table of contents", links to previous document menus and other related points of interest, and the electronic mail address for the responsible officer. Every document that enters the UNIDO WWW server receives this corporate image via a set of automated procedures. In the future, changing the corporate image for all documents on the server will be automated as well (figure 3, a sample document on the UNIDO WWW server).

The structure of the server is clearly defined by a set of hierarchical arranged menus. Users who want to jump directly to a specific menu may simply select the text "outline" to jump to a "clickable outline" of all menus on the server (figure 4, The "clickable" outline).

Getting the right message to the right person

Clickable e-mail addresses

Every document on the server has a set of electronic mail contact addresses at its end. With most WWW browsing software—including Netscape (TM), Mosaic (TM), Lynx and others—the user may direct a message to the appropriate officer simply by selecting the hypertext link containing the e-mail address.

Online forms

Many points of interest on the UNIDO WWW server (for example, the India Intechmart—<http://www.unido.org/services/ip/ipopportunities/ipmeetings/ipmeetings14.htmls>) use "HTML forms" to assist the user in structuring their reply to the relevant officer. If the user finds it impossible or inconvenient to fill out the form "online", an alternate

version may be printed out and sent by mail or fax (figure 5, an online registration form).

Plans for the future

Downloadable information products

1996 will see the arrival of several downloadable "product samples" on the UNIDO server. Two such anticipated products are UNIDO's statistical databases and feasibility studies software (COMFAR).

Databases

Research and development is currently under way to make many of UNIDO's databases accessible to the WWW public. Especially important is the work under way to make Micro CDS/ISIS databases searchable via HTML forms. This groundbreaking work is being undertaken by UNIDO, in co-operation with other entities, including UNESCO (the maker of ISIS) and the Institute for Computer Information Engineering (Warsaw, Poland).

Addressing the whole Internet

Even given the benefits offered by the WWW, care must be taken to accommodate those who, by choice or

necessity, still use older methods to retrieve documents via the Internet (E-mail, Gopher). To this end, all documents on the UNIDO WWW server are stored twice—once in the UNIDO "corporate image" framework, and once in the simplest possible HTML form, so that conversion to simpler formats (preformatted ASCII) can be automated and delivery via electronic mail and Gopher will be possible at a future stage in this fledgling (but extremely promising) information service's continuing development.

Selected references

Hobbes' Internet Timeline v2.2

<http://info.isoc.org/guest/zakon/Internet/History/HIT.html>

Summary of the Results. Second TIC/MIDS Internet Demographic Survey

<http://www1.mids.org/ids2/ids2.504>

For further information, please contact Robert Bullington at UNIDO on rbullington@unido.org

Figure 1

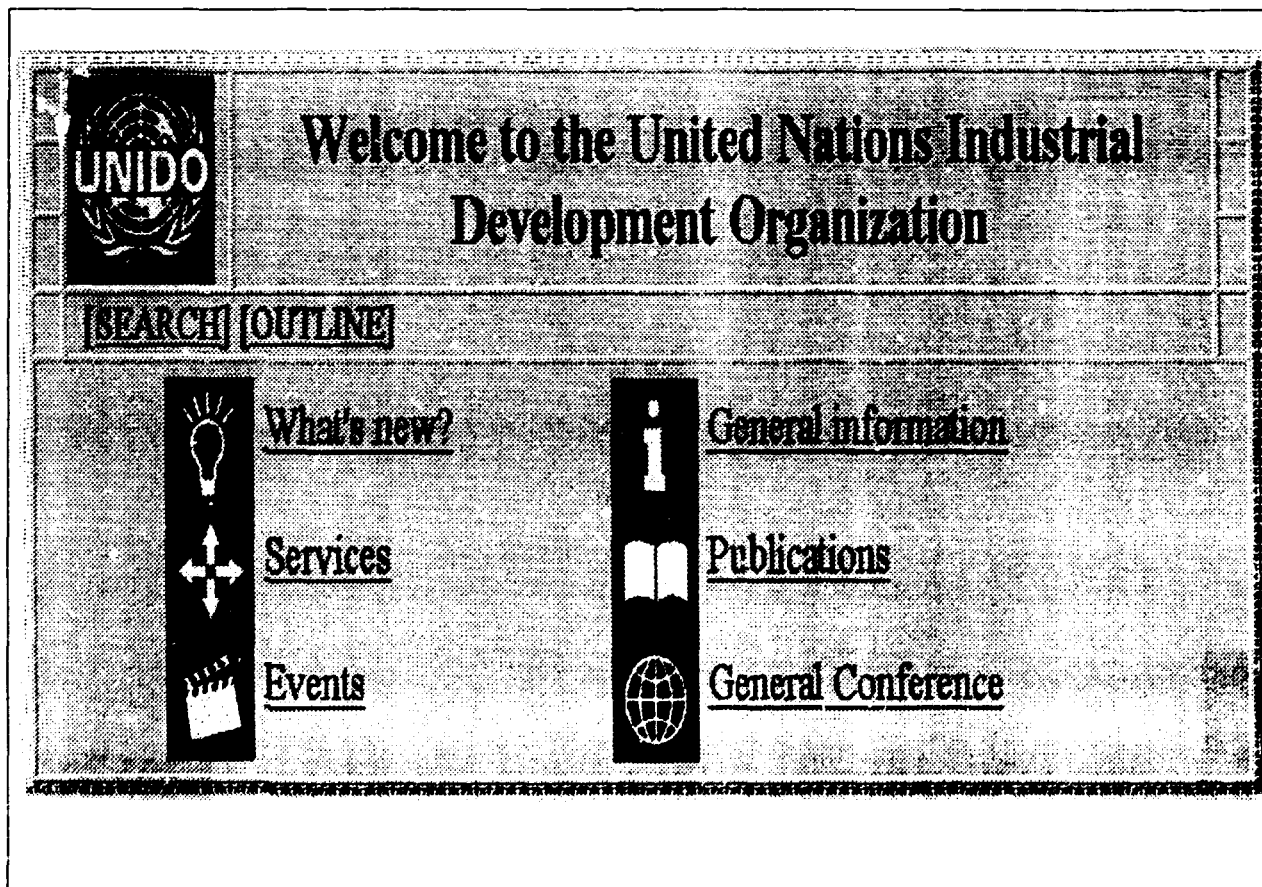


Figure 2

WAIS Gateway

This is a searchable index of information.
 Note: This service can only be used from a format-capable browser.

Enter keyword(s):

Here is the result of your search using the keyword(s) investment:

- 1: Contents
 Score: 1000, Size: 376 bytes, Type: Server parsed HTML file
- 2: Registration Form - Common Form
 Score: 575, Size: 1 kbytes, Type: Server parsed HTML file
- 3: CUMPAE 4.1 Computer Model for Financial Analysis
 Score: 391, Size: 1 kbytes, Type: Server parsed HTML file
- 4: Preparation of Investment
 Score: 303, Size: 1 kbytes, Type: Server parsed HTML file
- 5: Sri Lanka Investment Commission
 Score: 242, Size: 1 kbytes, Type: Server parsed HTML file
- 6: Investment Bonanza in Sri Lanka
 Score: 212, Size: 2 kbytes, Type: Server parsed HTML file

Figure 3

UNIDO

Last Change: Friday, 24 Nov 95 10:23:48 PST

United Nations Industrial Development Organization

INDIA INTECHMART 1996

6702-1-95-20 (Internet)

Contents

- AN INTRODUCTION TO INDIA
- THE INDIAN ECONOMY
- RECENT PERFORMANCE
- CONSUMER MARKETS
- POLICY ENVIRONMENT
- FOREIGN EXCHANGE CONTROLS
- TRADE POLICY
- INTELLECTUAL PROPERTY RIGHTS
- FOREIGN INVESTMENT
- INDIA INTECHMART

Figure 4

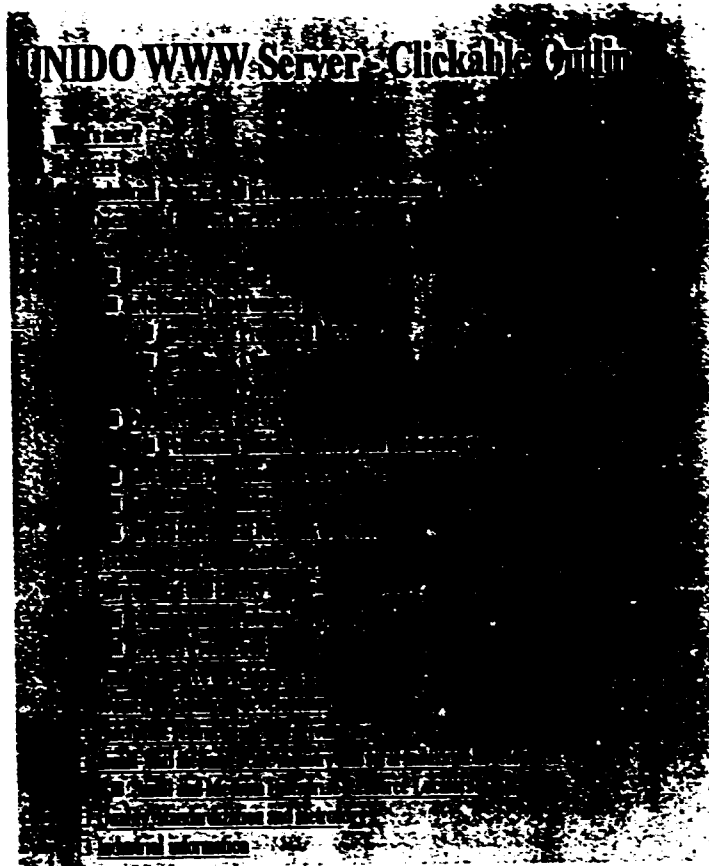
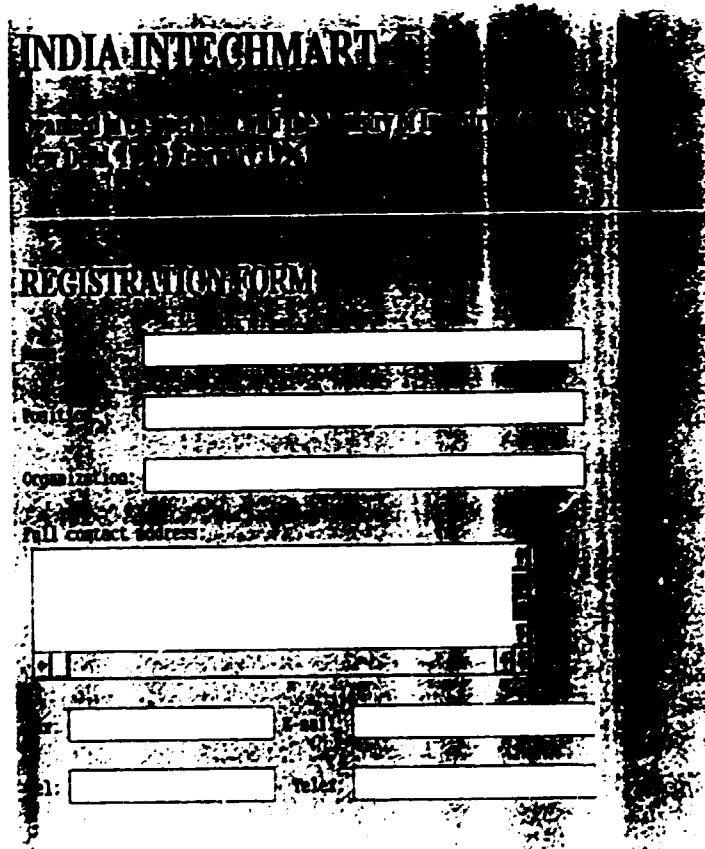


Figure 5



Should information be free?

At a recent conference, Sam Sternberg, a proponent of Toronto's new FreeNet, prophesied the end of commercial publishing, books, copyright, online information charges and all other obstacles to the free exchange of information between the citizens of a democracy. Some of his arguments are persuasive. All government-generated information has been paid for by the taxpayer and should be free. Work supported by government grants or contracts, such as that done by academics, should also be free. Information generated commercially should be released in order to promote competition and economic growth. More generally, every piece of knowledge we have owes much to the efforts of our forefathers and our contemporaries. Why should we be allowed to sequester it and exploit it for personal gain merely because we have added a tiny contribution of our own? Now that we have the Internet there should be nothing to impede the flow.

An alternative argument is to view information like water. We may not assume that all information and all water can be treated as homogeneous commodities where every byte and each drop are exactly the same as all others. Water is not a simple commodity and the price varies by a factor of almost a million depending on how it has been refined, treated, and made fit for a particular purpose. Often its value arises not so much from the fact that it is pure or sterile but from the fact that its quality has been certified by an accredited organization. Likewise, high-grade browsing information from primary sources which has been carefully reviewed, edited, published, indexed and archived is worth more than low-grade untreated information. (Source: *Felicitet*, May 1995)

Crime on the Net

Internet crimes break down into the same categories and are prosecuted under the same legal framework as other crimes. For example, many existing laws, including that of assault, can be used to charge people who "harass" others via the Net, although some US states have instituted highly specific laws which attempt to make it easier to prosecute various types of harassing activities, such as stalking, where an assault case would be difficult to prove. Illegal pornography is one of the most serious, and high profile, crimes which may be perpetrated via the Internet.

World-wide publication of Internet-relayed information means that the plaintiff can sue the country of his choice. English laws make it easier for the plaintiff to recover damages. If you carry something defamatory unwittingly you have to prove you were not at fault. US law states the opposite. However, there are further complications. It tends to be difficult to prosecute crimes on the Internet because it seems senior law enforcement officers are not really aware of the problem. There also seems to be an unwillingness to commit resources to something which does not leave behind much visible evidence. The FBI has been working with Scotland Yard and MI5, as well as investigative agencies in Canada, Australia and Europe and as a result of the G7 convention in Brussels representatives seem to be starting to recognize that existing regulatory approaches are no longer appropriate. (Source: *Internet*, 6 May 1995)

Changing contexts of communication (electric writing)

As the Internet becomes ubiquitous in popular culture, new questions are being raised about how computer mediated communication (CMC) will affect people's lives.

It has been suggested that the emerging electronic age has features that correspond to the development of culture of previous ages. All developing societies are presumed to pass through a phase when the oral culture is the only mode of storage, transmission and dissemination of information. A picture is probably the most direct way of recording an experience as it seems that many alphabets developed as a kind of shorthand for pictures. Despite the theoretical existence of writing in medieval Europe, it was still in many respects an oral culture. When print became available, the consequences were the same as for the written culture, but very much magnified. Literacy began to increase as a result of the greater availability of readable information. Printing changed the backward-looking view of society to look forward to progress and improvement. It also changed the physical format of books and had a standardizing effect on language and spelling.

In the electronic culture there is nearly instantaneous delivery of information, depending on the size of the document, competing network traffic, state of the destination computer and intermediate machines involved in forwarding, etc. Other factors to consider with respect to the electronic culture are that multiple copies can be provided easily, a single copy can be accessed by many, there are new, less linear, reading options, and consensus takes longer to reach but participation is more equal. Other points are that there is no strong etiquette or widely shared norms, collaborative work can be time and distance independent, communication can share aspects of both print and orality, and the gap between information rich and information poor may be widened. There are possibly chaotic and possibly catastrophic times —yet fascinating times— ahead for the Internet and its users. (Source: *Journal of Information Science*, 21(2) 1995)

Network security

Not only has the volume of traffic on the Internet grown enormously since its early days, but so has the nature of its users. The original users were the military, and the academic community, but increasingly traffic is being originated by businesses. As a result, the need for secure communication has become urgent. Until recently, there were two semi-standard data encryption algorithms in general use —RSA and DES— but these have now been joined by another. The NSA-originated Clipper chip is intended to provide ultra-secure encryption, but has aroused controversy by virtue of the fact that the NSA, i.e. the US Government, would have the capability of deciphering any messages using the system.

The US Government position is that completely secure communication must be denied to criminal or terrorist organizations, and that sufficient safeguards are in place to protect the privacy of innocent individuals or organizations. Widespread and vigorous opposition to Clipper, however, has been voiced. The questions raised fall under four headings: conceptual, security, legal and ethical.

It has been pointed out that criminals can avoid detection by simply not using Clipper-encrypted systems. The counter to this is that this would be difficult and expensive if it became a universal standard. There are doubts as to how secure the storage of the requisite keys would be in government hands. The third group of concerns centre on the laws relating to wiretapping and the interception of data. Finally, there is the belief that Clipper interferes with the constitutional right to free speech. (Source: *IASIE*, November/December 1994)

Independent information brokering

Many people dream of being their own boss. The opportunities for this are somewhat limited in the information industry, but independent information brokering is one area which does offer possibilities.

There are two key openings for information brokers: firstly those companies which have no in-house information staff at all, and which outsource work, and secondly those which may use a third party just for specialized tasks. In theory at least, the demand for such services should be growing. But what people do not bargain for necessarily are the practical difficulties inherent firstly in setting up a business, and then in running it. You have to look at things like the equipment you will need, how you are going to keep your information up to date, and how you will pay for subscriptions. There are many hidden expenses. Also, look at the records you will need to keep: contracts, accounts, tax, VAT, and so on.

Aside from the mundane yet all-important financial planning, you have to be sure who your market is, and how you are going to market your services to them. It is not enough just to have confidence in your own professional ability. If you are promising information, you need to have the credentials as a researcher. But marketing is very important as well. (Source: *Library Manager*, 6 April 1995)

Ensuring universal access to the information superhighway

The information superhighway will provide new economic opportunities, yet there is the distinct likelihood that not everyone will enjoy access. A US Census Bureau survey demonstrated that ownership of home computers was often determined by income and education levels, race and age. Access at present was heavily weighted in favour of upper-income, well-educated people in the 30-35 age group. National programmes are now attempting to link various citizen groups with the Net. There are also initiatives aimed at improving access on the part of the disabled.

One way of creating more users is to establish self-supporting electronic communities. An example is LatinoNet, launched last November in San Francisco and accessed via America Online (OA). This has rejected advertising and does not allow business subscriptions. Members pay \$60 p.a. in addition to the monthly OA charges. Special emphasis is placed on encouraging non-profit groups to become information providers. (Source: *Computing*, 6 April 1995)

Library services: free or fee?

Should information services be free or for a fee? The debate is not new. What is new is the level of the debate, and the importance of the questions. Are we, for example, witnessing the beginning of a new global class system, with all the goodies going to the information rich while the information poor get poorer? Is central government's attitude towards funding forcing libraries to charge fees to survive? Will home computing and the information superhighway make public libraries redundant unless they buy the latest technology?

The director of the Science Reference and Information Services at the British Library has absolutely no qualms about charging for librarians' time and expertise. It is a perfectly viable way forward for all libraries because the British Library is investing time in answering inquiries which the reader could not or would not do himself. It is

exactly the same as paying a solicitor for an hour's work. The British Library has a corporate policy that access to the collections themselves is free.

However, others contend that if you charge for information, people are having to pay for something they are entitled to. If people can help themselves to information, or if library staff can help people find information themselves, there is no reason to charge a fee. Of course, one of the barriers to access can be cost and so, reluctantly, fees have in some libraries been imposed on some aspects of the library service. As much as possible these are directed at institutional, rather than individual, customers. (Source: *Library Manager*, 6 April 1995)

Policing the Net

Bereft of any dedicated security force to check that the Internet is being used for legal and ethical purposes, the world's biggest network is the ideal medium to support instant transmission of, and access to, pornography, terrorist information and anonymous threats and insults. The Internet presents other problems, too. For example, it presents a convenient way of broadcasting copyright material, and it is an easy method of gaining access to restricted computer systems which are open to the Net.

Problems occur on the Internet largely because it is such an open and immediate communications and publishing medium. Never before has there been this kind of hybrid medium which is open to anyone and which crosses territorial boundaries so effortlessly. Laws designed for existing media, such as newspapers, TV, radio and telephones, will become increasingly irrelevant. The fact that there are different laws in different countries relating to elements such as obscenity and data protection complicates matters further.

Encryption of data and tagging of information will be the two technical elements which will help guard against some of the worst problems associated with the Internet. For example, if people want to use the Internet to exchange information that may not be suitable for everyone to read, such as pornography, then it should be suitably tagged or encrypted so that companies can set up systems to stop it being downloaded. It is also clear that more creative solutions to legislation of the Internet are needed than currently exist. (Source: *MicroScope*, 22 March 1995)

Publishing databases on the Internet

When publishing databases on the Internet five key issues have to be addressed. These issues are access, quality, support, marketing and staffing. Computer security is a major consideration and is naturally an issue of great concern to libraries and computer support departments. You must allow external users to have access to the server without allowing them to go beyond and gain access to confidential internal information such as staffing or financial records. Quality is a phrase we frequently hear nowadays in relation to electronic databases. Unfortunately the quality of data and of databases on the Internet is often given little attention. The excitement of being able to make information accessible so widely can cause people to forget responsibilities which would be enforced upon them by a more formal publishing structure.

Even with a good interface, user support is an essential, but often neglected, component of successful Internet publishing. Online help takes a lot of putting together, while printed documentation is also expected by users. It is very easy for a database service to get lost on the Internet so marketing is also important. The most

obvious way to publicize an Internet service is through mailing lists and bulletin boards on the Internet itself. A serious approach to publishing databases on the Internet carries considerable staffing implications. It is preferable to have someone on the staff who can carry out work with a full knowledge of the purpose of the database and of the organization's objectives. (Source: *Managing Information*, April 1995)

Staff perceptions of incentives and hurdles in the use of technology

Studies of the impact of computers on library personnel have found that staff members are experiencing increased stress as a result of hours spent at a computer terminal, rising productivity expectations, and confusion caused by rapidly changing technologies. The University of Nevada, Las Vegas, Library's Technology Committee surveyed library staff to determine their perceptions of the impact of technology. The Committee prepared a list of long-range goals that included technology-driven objectives. A survey was administered to library staff in spring 1994, to which 42 out of a staff of 84 responded. Questions covered supervisor impact, training, time, communication, equipment/software, and personal attitudes. Survey results were discussed and tabulated, and results showed that the Committee follow-up was feasible in areas of training, information, supervisory practices, equipment and software.

The major hurdles identified, which affected maximizing technology use, were staffing level, and equipment and software availability. The major incentives were personal and professional interest, and the efforts of the Technology Committee. Unfortunately, all the major hurdles reflect the need for a budget increase and will have to be dealt with slowly over time. The Committee's training efforts were viewed as haphazard and in need of a plan, although a progressive training schedule had been developed. This needs to be communicated more effectively. The survey also showed that supervisors must actively use the technology themselves, in addition to encouraging its use by their staff. Proper communication of the library's goals and consistently planned training are key elements in developing staff ability to function effectively. (Source: *Computers in Libraries*, February 1995)

The enterprise as a knowledge economy

An enterprise exists as a congress of knowledge and information, and management is the process that ensures that these are used effectively in the interest of an enterprise. The idea that knowledge and information are the fundamental drivers of economic growth at the national or company level is beginning to permeate management and economic thinking. The study of information use in an organization has to have a top-down orientation and be utilitarian in approach. Information handling covers the cost-effective deployment of the processes of information management covering acquisition, categorization, storage, reporting, and its distribution to users and the acquisition of the requisite variety of information that supports the operational requirements. This requisite variety of information for information mastery will enable managers to understand the organization, manage and control its processes and operations, make suitable inferences and strategy from surveying the external environments, deal with uncertainty and risk, and come to optimal decisions within a broad set of values.

The information support requirement covers internal, operational, strategic and generic factors, which are listed

in detail, and the strategic environment is diagrammed. In addition to good information management, information mastery also encompasses human networking and thought. It is reinforced by the effectiveness with which IT, computers and telecommunications are used to reinforce human cognition and information management. The ideal informatic system should ensure that the requisite variety of information acquisition and use match the delivery of information to the cognitive need, support and complement the cognitive process, provide the means for easy interpretation and transmission of cognitive action, ensure that management has a desire for information mastery, and integrate the system to deliver optimal informatic value. Each of these objectives brings its own design and implementation problems. A detailed accounting of the value of the informatic system may be seen from an extended information audit. (Source: *Aslib Proceedings*, April 1995)

Strategic information systems planning

A strategic information systems plan (SISP) is the process of setting up a programme for the implementation and use of information systems in such a way that it will optimize the use of a firm's information resources to support the firm's objectives. It involves matching computer applications with the corporate strategy and objectives of the company. A three era model is proposed consisting of data processing, management information systems, and strategic information systems. The nature of the strategic information system will vary from organization to organization. The two elements in planning are how to evolve the information system to support ongoing operations and how to use this to change the organization's competitive position.

A sample methodology is tabulated, which consists of 20 steps grouped into seven phases—establishing the planning process, understanding business strategy and needs, defining existing information systems, formulating required applications portfolio, formulating IT supply strategies, reporting and implementation, and maintaining the SISP. Criteria that should be considered are overview, consistency, communication, documentation, and rational decision-making. Proprietary methodologies used by a number of major companies are tabulated. It is concluded that a strategy must be implemented, evaluated, and continuously developed. (Source: *Information Services & Use*, 15(1) 1995)

Job creation in the information society

To investigate how the information society will affect the labour market, and with a view to preparing the labour market for the changes, the European Commission has launched a series of studies and projects. QUALT, under the Director-General for Industry (DGIII), is exploring the impact of IT on the quality of working life. The introduction of information technologies can provoke serious problems if employees resist change because of a lack of good technical and psychological preparation. The project is bringing together psychologists, sociologists, employees, employers and technicians to develop appropriate tools and methods for avoiding such problems. AD-Employ will assess the overall employment trends in Europe related to the use of advanced communications with a view to helping the Community use the technologies to stimulate new job creation. Directorate-General XIII (Telecommunications, Information Market and Exploitation of Research) is preparing a project in collaboration with the Commission's Social Affairs Directorate (DG V) which will measure the

social cost of information technologies in terms of net job creation in the telecom transfer sector or elsewhere. The information gathered in these projects will help public authorities assess and understand better the impact of information technology on employment and in consequence formulate policies to make the transition easier. (Source: *I&T Magazine*, Winter 1994-1995)

The role of traditional social science information providers within the Internet community

The Social Science Information Centre is part of the German National Social Science Infrastructure Services (GESIS) and is building two major databases on German language research projects and social science publications. There is currently a revolution in the development of interpersonal communication with electronic mail at its heart. Many of the new features of the Internet are based on computer mediated communication. From experience with HUMANIST, an electronic seminar project, it has been shown that serious use of new technologies can increase cultural vitality. In addition, it can be a productive task for a data-centred social science infrastructure service to make use of the new facilities provided by computer networking. Existing Gopher systems are nearly all structured in an unintelligent way, with information resources being offered by document type, geographical location, type of connection, etc. Content-oriented structuring usually does not follow any standard or systematic approach.

Because of the great number of Internet resources, it is obvious that future starting points will have to be by discipline or subject. By evaluating, structuring and crystallizing existing information and communication resources with Gopher menus or with World Wide Web hypertext links, a forum can be provided for scientific discourse. Discipline-oriented information specialists are in the best position to judge the new media in terms of its scientific potential, and should intervene to allow information on the Net to reach the necessary quality standards. Entering the Internet as information providers has consequences which may alter normal library and information business. GESIS services and products are offered or announced via a Gopher server split into three main activity areas. There is an electronic newsletter, announcements of publications and meetings, and Listserv activities and TELNET connections

to GESIS databases. The main task is to structure and organize material suitably for presentation on the Internet. (Source: *IFLA Journal*, 21(1) 1995)

Internet insights: how academics are using the Internet

It has been estimated that traffic on the Internet could rise to 300 million users by 1999, 750 million by 2000, and 1.5 billion by 2001. Academics were among the first users, and a survey of use was conducted on the Internet to determine how users in higher education used the network. The survey covered general questions on computer expertise, frequency of email use, access to telnet sites, frequency of connections to a variety of Internet sources, access to several file transfer protocols, use of navigational aids, and open-ended questions on the importance and use of the Internet. Respondents were competent computer users with a mean of nearly 13 years of computer experience. They were also generally experienced in email use with a mean of 5.77 years' experience. They also indicated some past experience with the Internet with an average of 3.39 years of use. Results are analysed and tabulated in terms of computer experience, use of selected Internet domains, number of respondents from selected countries, use of various Internet communication and TELNET resources, and use of selected Internet information sources and ftp archive sites.

Comments were generally supportive of the project and it is concluded that the Internet is a popular method for academics with computer experience to communicate with individuals and discussion groups using email. Gopher is used through the Internet for database access and, to a lesser extent, to transfer files from popular sites such as NASA. Advantages of the Net are speed, ease of accessibility, global access and interactivity. It overcomes barriers of time and distance for the distribution of specialized resources, and it breaks down status and gender. Disadvantages are that specialized knowledge is required to access and use the Internet. There is no security for network communications and there can be heavy traffic in connecting with popular remote sites. The results of the survey suggest that the Internet will grow in importance to its millions of current and potential users. (Source: *Computers in Libraries*, February 1995).

C. NEW DEVELOPMENTS

Superhigh-speed, long-distance transmission by optical fibre soliton

NTT Corp. has succeeded in an optical soliton transmission experiment at a superhigh-speed of 80 Gbit/s over a distance of 500 km. This was made possible by applying a new optical fibre soliton laser based on a higher harmonics-regeneration mode synchronization technique, a stable optical multiplexing technology using a planar lightwave circuit (PLC), and an optical demultiplexing technology using a non-linear loop mirror that enables high-speed pulse signal read-out.

The light source was a higher harmonics-regeneration mode synchronized optical fibre soliton laser. The oscillation timing is detected by the generated pulses themselves, and a function is incorporated to compensate distortion with a feedback circuit prior to oscillation as a laser beam, by which a pulse oscillation with an extremely narrow width of 3 ps is generated, which enables input of large-capacity optical soliton into the fibre. The oscillation wavelength is 1.55 μm , and stable oscillation over a long period of time is possible.

In the experiments, the new laser system oscillated pulse signals of 10 Gbit/s, and by dividing these pulse signals into eight parts by the optical multiplexing technology, it was possible to transmit 80 Gbit/s of data altogether.

The 80 Gbit/s optical pulses passing through the optical fibre cannot be converted into electric signals directly for read-out due to their tremendous speed. Therefore, optical demultiplexing was performed using an optical circuit called a non-linear loop mirror. This is a device for selecting one out of the eight pulses from the 80 Gbit/s optical pulses passed through the optical fibre for separating 10 Gbit/s of signals, by which read-out of superhigh-speed signals is possible.

The transmission speed of 80 Gbit/s attained through the experiments approaches the 100 Gbit/s speed that is the primary target for the realization of terabit-order communications, and the transmission over a distance of 500 km corroborates the superhigh-speed, long-distance communications technique applicability to futuristic optical networks as the trunk circuit. Further details from: Nippon Telegraph and Telephone Corporation, Press Relations, Public Relations Dept., 1-1-6, Uchisaiwai-cho, Chiyoda-ku, Tokyo 100. Tel.: +81-3-3509-3101, Fax: +81-3-3509-4290. (Source: *JETRO*, April 1995)

Nanotechnology

The world of tiny things is rapidly getting larger. Nanospheres and nanotubes are now familiar. But nanotapes? These adhesive tape-like materials, which have a sticky and a smooth side, could have applications as diverse as computing and microsurgery.

Nanotapes are the brainchild of Samuel Stupp of the University of Illinois at Urbana-Champaign. They are built up of molecules that are not quite long enough to qualify as polymers. Half of the chain is flexible, and half is rigid, so Stupp calls them "needle-and-thread" structures.

These molecules "know" they are supposed to assemble into a tape-like structure, says Stupp. The needles are attracted to each other, as are the threads; together they

arrange themselves side by side into a "mat". The needle side of the mat is hydrophilic and sticky, while the thread side is hydrophobic and "Teflon-like". Stupp can also make the needles covalently bond to each other, making the film stronger. Stupp's nanotape is actually a stack of these films, about 500-1,000 Å thick. It is strong enough to be handled, he claims.

There are many potential applications, Stupp says. For example, ultra-dense hard disks for powerful computers need to be protected from their reading heads—a single scratch or gouge on the recording surface could erase millions of bits of data. A layer of nanotape, with the needles stuck to the disk and the threads forming a slippery layer, would be much more robust than the fluorocarbon coatings currently used, he claims.

But it is the medical applications that are the most exciting, Stupp comments. Nanotapes could be cast into tiny tubes as replacement arteries and blood vessels. The sticky outer surface would bind itself to muscle and other tissues, while the smooth, hydrophobic inside would prevent blood clotting as it passes through. (Source: *Chemistry and Industry*, 1 May 1995)

Wirebonding through film with plasma deposited silicon nitride

Ionic Systems (Salinas, Calif.) has produced a room temperature plasma chemical vapour deposited (RTPCVD) silicon nitride film which allows successful wirebonding through the film. This eliminates the need to first remove the passivation from the bonding pads.

Although there is some disruption of the glass-like silicon nitride in the immediate vicinity of the bond, this disruption is limited to a small portion of the bonding pad. Electrical and mechanical tests indicate that the bond does not have higher resistance values compared to a pad without silicon nitride, and pull strengths of the attached wires exceed that required by mil-std testing.

Bonding to date has included both wedge and ball bonding with aluminium and gold wires onto both aluminium and gold structures. Bonding operations have been successfully performed on a variety of analogue and digital circuitry including microelectromechanical systems (i.e., pressure sensors and accelerometers), environmentally protected chip-on-board (EPCOB) assemblies and hybrids. (Extracted with permission from *Semiconductor International Magazine*, April 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA.)

Simple full-colour LEDs

A single organic material is the basis for miniature light-emitting diodes (LEDs) that generate red, green and blue, the three primary optical colours, and that could readily be induced to emit purple, or even white. Ordinarily three chemicals must be integrated to achieve a full-colour electroluminescent flat-panel display—a difficult and expensive manufacturing process.

To produce the LEDs, a team at AT&T Bell Laboratories in Murray Hill, NJ, played games with Alq(8-hydroxyquinoline) an organic compound patented by Eastman Kodak Co. Alq can emit only greenish light, but the wavelength can be changed by passing the light through carefully tailored microcavities.

Essentially, the team's members layered Alq over a terraced transparent surface and sandwiched the result between two mirrors, one terraced and one flat. Hence the microcavities.

Going beyond the primary colours of red, blue and green, the team has been able to produce LEDs with microcavities that can emit mixed colours such as white and purple. The white-light LEDs may make it possible to develop thin, low-voltage backlighting for portable displays.

Although the laboratory prototypes use Alq, the fabrication process does not limit the LEDs to any one organic material. (Extracted from *IEEE Spectrum*, February 1995)

Sharp develops 1 Mb ferroelectric memory

Ferroelectric memory is expected to be the key to larger memory capacities in portable information terminals, PC cards, portable computer main memory, video memory and magnetic media sectors.

Finer rules have been difficult to achieve with traditional technologies, but Sharp resolved the problem by adopting a stacked structure and developing an 0.6 μm microfabrication technology.

The memory cell needed to store one bit of information is composed of two devices: one capacitor and one transistor. The ferroelectric material is PZT, used as the insulating film for the capacitor. The memory cell functions as DRAM when power is applied, and maintains data as NVRAM when power is off.

The company also developed a dry etching process with submicron precision for the ferroelectric and electrode materials in the capacitor. The capacitor-machined shape is precise to within 0.1 μm of the mask pattern, making possible a 0.6 μm rule.

Application of the new technologies resulted in a cell size of 10.5 μm^2 with an operating voltage of 5 V. This memory cell was then used to prototype a 256-Kb test chip. The new technology will be further extended, leading to the development and practical application of megabit-class ferroelectric memory. (Reprinted with permission from *Semiconductor International Magazine*, April 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA.)

Breakthrough in thin film resistor

In what is being described as a landmark technological breakthrough, Materials Research Corp. (Orangeburg, NY) has achieved what has long been considered unattainable in the development of thin-film resistors: a temperature coefficient of resistance (TCR) guaranteed not only to be essentially zero across the wafer substrate but also reproducible from wafer to wafer in high volume production quantities.

The achievement is the result of a new process recently introduced by MRC's Advanced Technology Division, which enables the development of stable tantalum nitride (Ta₃N₅) thin films with a uniform TCR of 0 \pm 25 ppm/°C across a 6-in. wafer (the largest size used by resistor manufacturers). MRC also says that its new Alta reactive sputtering system eliminates the need for the costly, time-consuming post-deposition process normally required to bring thin-film resistors within their specified tolerances.

According to MRC, the new Ta₃N₅ process was tested at temperatures ranging from room temperature to a maximum of 150°C. In all cases, the average TCR measured at

discrete points around a 6-in. wafer was "virtually zero" and always within \pm 25 ppm. (Reprinted with permission from *Semiconductor International Magazine*, April 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA.)

Industry's first 128-bit graphics accelerator

High performance PC graphics based on the 64-bit version of the PCI bus have moved a little closer to the market with the launch of the industry's first 128-bit graphical user interface (GUI) accelerator from Integrated Micro Solutions (IMS).

According to IMS, the single chip GUI and video coprocessor is the first to be equally suited to both Windows/DOS and Macintosh/PowerPC environments. It will support local graphic transfers on the PC of 2 Gbyte/s and sustained PCI bus related operations are in excess of 100 Mbyte/s.

That matches the throughput of the market-leading GUI for the 32-bit PCI bus offered by Californian-based Trident Microsystems.

The IMS device can be used with both 32- and 64-bit versions of the PCI bus.

In a separate development, Diamond Multimedia Systems, the PC graphics card supplier, has introduced a 64-bit PCI-based graphics accelerator.

Based on S3's 64-bit Vision868 GUI accelerator and its shared frame buffer architecture, Diamond's Stealth graphics accelerator provides 30 frames per second full-screen video playback on 486-based PCs running under Windows 3.1. (Source: *Electronics Weekly*, 3 May 1995)

Storage in quartz

A piece of quartz 2 cm² and 2 mm thick has the potential to store as much data as 100 compact discs, claims Hiroaki Misawa at the University of Tokushima in Japan.

He said that his group had successfully written 350 layers of data in a quartz slice 1 mm thick using a microscope and a pulsed laser.

Storage relies on the refractive index of small volumes of the material being changed. (Source: *Electronics Weekly*, 3 May 1995)

Natural born cells

Techniques borrowed from plant and bacteria photosynthesis are allowing cheaper solar cells to be made. Knowledge of this natural process has reached a stage where synthetic analogies have been made and are delivering energy. Further discoveries in biochemistry could improve the efficiency of these, or result in new forms of cell, that have efficiencies that far exceed those of today's commercial silicon solar cells which rarely exceed 16 per cent.

One of the new generation of solar cells is being investigated under Joule II, the EC programme for the development of renewable energy sources. It is called the Grätzel cell after its inventor, Professor Grätzel of the Ecole Polytechnic, Lausanne.

Dr. Donald Fitzmaurice of University College, Dublin, the coordinator of the EC programme, said: "The cells have a lower technology content than amorphous silicon cells, are much cheaper and contain no environmentally damaging materials."

Among other uses, the cells are seen as a potential power source in poorer countries which would not require foreign investment

The structure of the cell is quite straightforward. It has conductivity-coated glass front and back. The anode, on the inside of the front glass, is formed from a layer of titanium dioxide. The inside surface of the oxide is coated with a dye that absorbs light and releases electrons.

Evolution has specialized plant leaves to catch the maximum amount of incident light. To do this they have layers of photosynthesizing molecules. Each layer acts as a backstop, catching photons that slip through the previous layer. This is simulated in the cell by creating a "fractal" surface where the dye-coated layer is overfolded on its self many times.

Each square centimetre of the resulting anode surface has an actual surface area of 1,000 cm². It is the anode that gives these Grätzel cells the name "nanocrystalline solar cells".

The new cell converts energy with an efficiency of 10.2 per cent. This compares favourably with amorphous silicon which is 12 per cent efficient, dropping to 11 per cent over time. The cell gains over the conventional cells when operated in direct sunlight because, whereas rising temperature decreases the efficiency of silicon solar cells, it raises it in photosynthetic cells.

Dr. Fitzmaurice said: "The efficiency of this type of cell is limited by the current knowledge of photosynthesis. Better understanding of this should enable improvement in the design of cells of this type."

The Glasgow team has discovered something that traps additional photons and has dubbed it the "antenna structure".

Measurements of the antenna structure have shown some surprising properties. Perhaps the most remarkable of these is that over 90 per cent of incident energy is converted by the antenna and reaction centre into electric charge. Figures as high as 97 per cent have been recorded. The other remarkable property is the speed. The whole process of light harvesting, excitation transfer and charge separation takes place in less than 100 ps.

By understanding the exact arrangement of the pigment molecules the team can now, in concept, mimic the photosynthesis action in a non-biological matrix.

Markets that are currently closed to solar generation, or any form of generation, could be opened up with minimal environmental cost by further developments in photosynthetic solar cells. According to Dr. Fitzmaurice, the results of a Swedish study commissioned for the programme are a compelling argument for solar power. The power requirement for the whole of Sweden is 150 TWh per year. Fifteen TWh, or 10 per cent of the country's power requirements, could be met by covering all the country's south-facing roofs with 12.5 per cent efficient solar cells. This is remarkable when the dilute nature of Sweden's sunlight is taken into account.

Dr. Fitzmaurice claims that most of the cost of photosynthesis-based solar power farms would be in land purchase and the panel supporting structures. These supplementary costs would disappear if roofs were used.

Photosynthetic cells are estimated to cost \$59 per square metre in volume production. The study concluded that the installed cost of roof panels would be \$600 per kWh. This compares favourably with \$4,750 for existing solar cells and \$925 per kWh for wind power or coal. It is worth remembering that the Earth receives 8.3×10^8 TWh of solar energy per year and that 0.1 per cent of its surface covered with 10 per cent efficient cells could provide mankind's energy needs. (Extracted from *Electronics Weekly*, 3 May 1995)

Solar eclipse

Dr. Keith Barnham, Reader in Physics at Imperial College London, and his colleagues, with a little help from industry, are working on ways to improve the efficiency of solar cells.

Semiconductor solar cells produce electricity by absorbing photons in, or near, a p-n junction. The photons create electron-hole pairs which, once they are established, drift across the junction under the influence of the electric field from the doping of the p and n type semiconductors, resulting in current flow in any external circuit.

One of the features of sunlight that makes it so difficult to catch is that it has a spectrum. That is, it consists of light at a variety of wavelengths, or has photons of varying energies.

A "normal" solar cell has a fixed band gap and can only usefully absorb photons of sufficient energy to boost electron-hole pairs across the semiconductor's band gap.

Photons with less energy than the band gap are not absorbed at all. Higher energy photons give the pairs far more energy than is required to push them across the band gap. Any superfluous energy above the band gap is wasted as heat when the pair fall back to the band gap level.

All this means that conventional solar cells absorb light at one wavelength very well, but less effectively over the range of wavelengths in the solar spectrum.

Dr. Barnham's group has introduced thin layers of material, called quantum wells, into the semiconductor junction. These thin layers, only a few nanometres thick, are interspersed between layers of the native semiconductor and have a lower band gap.

Extremely thin layers of semiconductor behave differently than the same material in bulk. The distinct energy levels that electrons can occupy theoretically are "blurred" in mass material, but exist in thin layers.

Photons of insufficient energy to push pairs over the band gap of the host material may still have sufficient energy to create useful pairs in the quantum well material.

The Imperial College group has shown that the electron-hole pairs last long enough, a few nanoseconds, to escape from the wells. They escape because thermal energy in the semiconductor is often enough to raise the energy in the electron or hole high enough to move it into the band gap of the adjoining native layer. It then drifts through this, falls into the next well and the process is repeated.

The native material can be chosen with a high band gap to give a high cell voltage, but the current remains high because a large number of photons are absorbed.

So far all the work has been done with expensive gallium arsenide (GaAs), rather than cheaper silicon. There are two related reasons for this. Silicon absorbs photons by a more complex, "indirect", route that does not lend itself to this kind of process. And quantum well technology in silicon is still in its infancy.

Barnham said: "GaAs has two advantages. It needs 100 times less material than silicon to absorb the same number of photons and its theoretical efficiency is higher than that of silicon", and added: "The increasing demand for it for optical computing and lasers is bringing the price down."

Quantum well solar cells have the potential to extract more usable energy from sunlight than conventional cells. This is because they can absorb a wide range of photons but retain a high cell voltage. They can only be made in gallium arsenide and aluminium gallium arsenide at this time, but the concepts may transfer to silicon as silicon

quantum well technology improves. (Source: *Electronics Weekly*, 31 May 1995)

Gallium arsenide joins the giants

Gallium arsenide has enjoyed a unique position in the electronics industry for more than 25 years. Yet, in all this time, the unusual properties it shares with other III-V compounds have been applied only to rather simple circuits. Examples are solid-state lasers and emitters of visible or near-infrared light, as well as radio frequency and microwave amplifiers. Each requires high performance, but none needs more than a few transistors and diodes per chip.

Breaking with this past simplicity, GaAs is emerging as the starting material for integrated circuits with one million or more transistors per chip. The technology today is firmly in the domain of high-performance, very large-scale integration (VLSI), with chip clock rates hitting 100 MHz and up. And to cap everything, the manufacturing cost is reasonable.

GaAs VLSI technology got under way in earnest less than eight years ago and in short order has shot up spectacularly in complexity, or number of transistors per chip. Because the transistors in GaAs VLSI switch very swiftly, logic gates based on the devices impose much less delay on signals than does the silicon variety. The VLSI performance that results is either impossible or difficult to attain with silicon. For example, the shortest silicon CMOS gate delay is about 150 ps versus 70 ps for GaAs, both in 0.5- μm technology. As for commercial success, GaAs VLSI has excellent prospects, being the offspring of a very simple process married to silicon IC manufacturing technology and equipment.

Present forms of GaAs VLSI are higher-performing versions of silicon VLSI. The GaAs transistors just speed up the same old IC concepts. Still in the future are truly novel chips, incorporating devices like optical emitters or microwave amplifiers that can be built only in GaAs III-V compounds.

VLSI manufacturing can be characterized as the art of layering a chip with lots of transistors having reasonably similar characteristics and connecting them on that same chip without shorts or opens. By this stage, "lots of transistors" can mean several million, and "connecting them" entails hundreds of metres of approximately 1- μm "wires" separated by spaces of 1 μm or less.

As luck would have it, GaAs VLSI did not have to reinvent this art. The bulk of the production process is copied directly from silicon and uses the same equipment. In fact, GaAs VLSI manufacturing has more in common with silicon CMOS technology than with earlier GaAs. A key difference, however, exists between the two VLSI processes: fewer steps are needed to produce GaAs circuitry. Granted, the fabrication of the wiring levels, which forms the bulk of the process, is identical for both technologies. But only four mask levels are needed to define the GaAs transistor compared with six for the silicon device. The simplification to some extent offsets the greater expense of the GaAs starting wafers.

Both these VLSI transistors are the offspring of ion implantation: ion beams impregnate the starting semiconductor material with dopants. The devices are also alike in being field-effect transistors, current flows between their source and drain whenever a voltage is applied to their control terminal (gate), generating an electric field between the gate and the channel. But in crucial ways the two differ.

First, the conducting channel (n-channel) is created in the GaAs device by a separate implantation step, whereas in the silicon device, the n-channel is created electrically, by "inversion" of the p-type material. Second, in the GaAs device, the electrons forming the current pass a little beneath the semiconductor surface; consequently, the electron dynamic behaviour of the buried-channel device is ruled by the semiconductor's bulk properties. In the silicon device, the electrons stream across the surface of the semiconductor and behave in accordance with surface properties.

A third influential difference is gate insulation, or its absence. In the silicon device, the gate is separated from the semiconductor surface by a thin oxide layer, producing an insulated-gate device. In the GaAs transistor, the gate electrode contacts the semiconductor surface directly, forming a diode between this terminal and the channel.

The whole reason for using the III-V compound to build VLSI is to get the highest level of performance possible. In some cases GaAs can scale heights of virtuosity otherwise inaccessible. In others, the margin of speed granted by the III-V compound obviates any need for the parallel processing of data, resulting in a less costly logic implementation that uses fewer transistors and occupies less space.

In point of fact, performance means different things in the context of different applications. Thus computation and communication, whose leading edges keep digital chips on the run, so to speak, require rather different things of the technology.

To sum up, each generation of VLSI technology can outperform its predecessor, thanks to reductions in chip geometry. But as features shrink well below 1 μm , electric fields must also be contained by reducing power supply voltages. This last turn of events slows signals in MOS ICs but not—in at least until the 1-V level is reached—in GaAs ICs.

Moreover, GaAs transistors will surpass even their present record-breaking performance if built as heterojunction devices. Completely new VLSI concepts will then be implemented, like chips with RF receiver and transmitter front-ends, realized with no greater process complexity. Imagine an all-digital radio in which the RF signal is converted directly into digital signals and all of the subsequent signal processing is digital. The upshot could be truly inexpensive transmitter receivers, since most circuit adjustment would be eliminated. Heterojunction GaAs devices could have optical transmitters and receivers incorporated alongside them in VLSI circuitry, opening up other areas of application.

The question of the hour, though, is this: what markets is GaAs VLSI poised to dominate now? In other words, where is GaAs VLSI clearly the cost-effective solution? At present, the fastest-growing segment is in the manipulation of high-speed serial digital data.

In the computer area there are several burgeoning applications, such as 1-Gb/s transfers of the torrents of data that rush between disk arrays and CPUs. In telecommunication, the fastest growth is in the interface with optical fibres, where serial data is processed at 2.5 Gb/s today and maybe 10 Gb/s tomorrow. In short, today's demand for GaAs VLSI is being driven by the market for high data rates that conform to internationally sanctioned standards. (Examples are fibre-channel for disk interface and Sonet or SDH for telecommunication optical-fibre interface.)

Since high-speed connections must exist between CPU buses, between CPU and disk, and between CPU and local-

and wide-area networks, the pooled market is on the brink of sudden expansion. It will be most thriftily served, and therefore may well be dominated, by GaAs VLSI. (Extracted from *IEEE Spectrum*, February 1995)

German researchers study superhard thin films

The hardest material in the world is, as ever, the diamond. Now it is receiving competition: cubic crystal boron nitride and carbon nitride are promising candidates for the production of extremely hard films.

Superhard films are of interest because extraordinary wear characteristics are obtained—in high-performance tools, for instance. In addition, these filmy but highly resistant coatings offer protection against corrosive chemicals and corrosion. The diamond is suitable only to a limited extent for the often only one-micrometre-thick films. The reason: "The diamond reacts with materials containing iron", explains Frank Richter, professor of solid-state physics at Chemnitz Technical University. Therefore, steel cannot be machined with diamond-coated tools.

Another material which has at this time been developed in the research laboratory—cubic crystal boron nitride—does not have this disadvantage. The crystal, consisting of boron and nitrogen, occurs in nature only in its hexagonal form, which is a soft graphite-like material. The cubic variant, however, matches the crystal lattice of the diamond, except that two kinds of atoms are involved instead of just one. Small crystals of superhard boron nitride form only under a pressure of several dozens of bars and temperatures of between 1,000° C and 2,000° C.

Scientists can make the hard material also under less extreme conditions, and in fact as a thin film by means of special deposition processes. For this purpose boron is heated in a vacuum chamber by means of an electron beam and vaporized. The boron particles are "shot" together with nitrogen ions onto the surface to be coated. The atoms settle together there, but without forming a sufficiently hard film.

While the boron-nitrogen film grows layer by layer, it is subjected to constant bombardment with high-energy argon or nitrogen ions. These ions are so fast that they penetrate several atomic layers deep into the growing film and thus feed relatively large amounts of energy into the system. The film is constantly packed by means of the ions. Tiny but superhard microcrystals with a diameter of a hundredth of a micrometre form only then.

It is to all appearances exactly at the point of impact that the boron and nitrogen particles crystallize to the desired cubic lattice.

None of the theoretical models can at present satisfactorily supply information concerning the course of this process. There are also still great difficulties with the film's adhesion. Once these obstacles are overcome, then the optically transparent boron nitride could serve, for example, as a hard, extremely scratch-resistant coating for panes of glass. The advantage is that scientists could design window panes, for instance, that let sunlight through but reflect heat rays. (Extracted from *VDI Nachrichten*, 14 April 1995)

NEC develops observation semiconductor laser

NEC has developed a semiconductor laser which can be used to discover abnormal conditions, such as circuit breaks in a fibre optic network, even while communications are taking place. The laser emits high-power light in a wavelength not used for communications purposes. The system is able to determine where the

abnormal condition has occurred by the condition the light is in when it returns. Observation lasers have up to now used light with the same wavelength as that used for communications, and they were therefore unable to be used unless communications were terminated. This is a technology which can be used to "watch over" communications nets in this multimedia age, in which fibre optic nets will spread to the homes of every user.

The laser emits light with a wavelength of 1.65 microns (1 micron equals 1/1,000 of a millimetre), a wavelength not used for communications. The laser emitters used the "deformed quantum lath formation", which is composed of indium, gallium, arsenic and phosphorus and which has a high electricity-to-light conversion efficiency. Through this kind of element formation, it was able to obtain high output powers of 156 milliwatts with an electrical current of 400 milliamperes. Earlier lasers that emitted light at a wavelength of 1.65 microns had a lower output power.

If this laser light is passed through optical fibre, abnormal reflections will result from areas where the circuit is broken or where the fibre is kinked. Through analysing this light, the location of the broken circuit, or the point where there is the danger of the circuit breaking, can be determined. Light with a wavelength of 1.65 microns does not interfere with light used for communication purposes, such as light with wavelengths of 1.3 microns or 1.55 microns; therefore, observation can occur while communications are taking place. (Source: *Nihon Keizai Shinbun*, 27 March 1995)

Mitsubishi materials develops new method for producing 8-inch wafers

Mitsubishi Materials Company has succeeded in the production of 8-inch silicon wafers by using a monocrystal continuous pull-up method (Czochralski method, CZ). This is the world's first successful production of an 8-inch wafer employing a continuous CZ method.

The 8-inch wafer that was cut from the 8-inch monocrystal silicon was distributed to semiconductor makers as a sample, and the company is planning to start sales soon.

In the CZ method, polycrystal material placed in a quartz crucible is melted at 1,420° C-1,430° C, and the melted surface is brought into contact with monocrystal silicon as a seed, and a stick-like ingot is obtained by rotating and pulling up gradually. For the batch method, when the polycrystal material in the crucible is gone, the operation must be stopped. But the CZ method that Mitsubishi developed continues to operate, adjusting the supply material in the crucible and maintaining the amount of melted silicon constantly. Mitsubishi Materials has mass produced a 6-inch wafer employing the continuous CZ method.

In the batch type CZ method, an ingot with a length of a little less than 8 inches is the maximum limit, but with the continuous CZ method it will become possible to make longer lengths. Mitsubishi succeeded in growing a 2-metre length, and the company believes that if the process of contacting new seed crystal and pulling up is repeated while the grown ingot is moved, then continuous production of an ingot will be possible.

In the batch method, while the ingot is growing, there is a disadvantage of falling electrical resistance that is most important for product quality. But with the continuous method, the electrical resistance level of the ingot was consistent, and the product therefore has superior quality. (Source: *Nihon Kogyo Shinbun*, 5 April 1995)

Fujitsu develops dry-washing technology for silicon epitaxy

Fujitsu has developed a low cost, low temperature dry-washing technology that will replace hydrogen anneal processing, and the company verified its effectiveness by growing silicon epitaxy. The technology employs a low temperature of 100° C using steam vapour with a hydrogen plasma down-flow mixed with nitrogen fluoride. Silicon epitaxial growth on the processed wafer made it possible to create a film surface with fewer defects almost equivalent to that produced by hydrogen annealing. Hydrogen annealing requires a high temperature, expensive equipment and operation, but the new technology is safer to operate and advantageous in cost.

The developed dry-washing technology removes the natural oxide film or particles attached to a silicon wafer. To clean the wafer surface, traditionally wet washing by fluorine oxide or dry processing by hydrogen annealing have been employed, but as surfaces become increasingly small, a dry-washing process that requires low temperature and yields fewer defects was needed.

With the new method, epitaxial growth was accomplished easily, demonstrating the cleanness and flatness of the surface prior to film formation, and the effectiveness of cleaning by the new technology was evaluated. (Extracted from *Nihon Kogyo Shimbum*, 31 March 1995)

Toshiba creates single electron tunnel transistor

Toshiba has succeeded in manufacturing the first experimental model of a single electron transistor (SET) in a simple form using current silicon ultra LSI technology. Although a silicon SET experimental model, which is operational at room temperature, had been introduced before, the problem of reproducibility and integration remained to be resolved. This time employing current ultra LSI processing, including the same exposure and etching technique, an experimental model which can be reproducible was realized, and operation was verified at a liquid helium temperature of 4.2 K. If minuteness is further refined, performance will increase and room temperature operation will be possible. It is said that this experimental model will be a good candidate to replace the next generation MOS LSI that will eventually have problems when circuits become even more miniaturized (Extracted from *Nihon Kogyo Shimbum*, 31 March 1995)

Team develops energy recycling LSI element

Professor Kiyoshi Kawamura and his research team at Keio University have come up with a "correlational tunnel element" that can recycle the energy lost while current is flowing in the circuit, and its function was successfully verified by simulation. Electrons in two quantum boxes are placed close enough to create a mutual Coulomb effect, and oscillation energy of quantum electrons is utilized. The energy lost while electrons are flowing is transferred to other quantum boxes, so that the device realized energy recycling. In the past, controlling power consumption as much as possible was the basic idea, but the new LSI element established a new concept of transferring the energy consumed for recycling. No heat is generated, and it is expected to apply to future high density LSI.

The device does not have an amplification function and a resistor without heat is assumed, but is fundamentally the turning point of looking into the possibility of low power consumption for LSI. Also, since the device can store the energy consumed while current is flowing, it can be used for a battery. Additionally, it can be applied as an electron

counter if the electrical phase of the upper quantum box is measured, and the number of electrons dropping to the lower circuit is counted. (Extracted from *Nikkan Kogyo Shimbum*, 29 March 1995)

Sanyo develops decoder chip for world's first eight-speed CD-ROM

Sanyo has developed a CD-ROM decoder for personal computers that can interface with the revolution speed eight times faster than the current one, and it plans to ship two types of sample units. The decoder Sanyo developed is an LSI that reads data written in CD-ROM and corrects errors. Sanyo developed the LSI jointly with Western Digital (WD), a major US HDD maker, adopting the ATAPI industry standard completely. This is the industry's first and fastest decoder LSI that makes it possible to interface with a speed of 16.6 megabytes per second revolution. The company will start mass production and sales in late 1995. The new LSI will replace the current unit that interfaces with the 4X driver.

ATAPI is the industry interface standardization for personal computers combined with CD-ROM drive integrating hardware and software. Next generation operating systems, such as Chicago 95, plan to include the device driver for CD-ROM, assuming industry standardization.

The device developed this time not only can interface at 8X, but also has a multiblock transmission function that can transmit data as a multiple block. (Source: *Nikkan Kogyo Shimbum*, 23 March 1995)

Research establishment develops silicon nitride fibre using radiation

The Takasaki Research Centre of the Japan Atomic Energy Research Institute (JAERI) has succeeded in developing a process that uses radiation to produce silicon nitride fibre that provides both heat resistance and electrical insulation. The unique feature of the development is the electron beam irradiation in helium gas of fibres obtained by high-temperature melt spinning of polycarbosilane (PCS), a silicon base polymer. Silicon nitride fibre is obtained by heating these fibres, which now are non-fusing. The resulting fibre has excellent electrical insulation capability and can withstand high temperatures of around 1,000° C. Future uses of this new ceramic fibre will be watched with interest.

JAERI has been involved for two years in the development of the technology of using radiation to manufacture silicon base ceramic fibre (silicon nitride) from organic polymer fibre. JAERI believes that this ceramic fibre can be used for heat-resistant electric lines or electric line cladding. (Source: *Kagaku Kogyo Nippo*, 6 April 1995)

Mitsubishi develops DVD system with 135-minute capacity

Mitsubishi Electric has successfully developed a digital video disk (DVD) system using a high-density optical head technology combining a short wavelength laser and a high-NA (numerical aperture) lens.

Multimedia systems now generally handle large-volume image data such as still and video imagery. As a result, the market demands technologies for high-resolution imagery and high-speed signal play processing. A combination of optical disk record play technology, laser diode technology and optical head technology was used to compose the DVD system, which is positioned as the core of multimedia. In addition, because CD-sized media are used, the systems themselves can be made smaller.

The new system uses a red laser (635 nm) and a high NA-lens, with a laser spot size for reading data significantly smaller than that used in normal CD players. The use of a compact shaft-driven rotating actuator improves reliability during signal play. The firm also developed a 49 modulation scheme with excellent recording density and high signal detection reliability. The new system combines these to achieve a performance index about 1.3 times higher than the EFM modulation scheme used on standard CD players.

The new technologies provide a high image quality, with capacity for 135 minutes of imagery on a CD using MPEG-2 compression. (Reprinted with permission from *Semiconductor International Magazine*, May 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA.)

World record stationary magnetic field using 40 tesla hybrid magnet

Japan's National Research Institute for Metals (NRIM) of the Science and Technology Agency (STA) will use a "40 tesla class hybrid magnet", which is under construction at the strong magnetic field station, to take up the challenge of achieving the world's strongest constant magnetic field, 36 tesla. This magnet is equipment to generate a strong magnetic field and is composed of a superconducting magnet on the outside and a water-cooled copper magnet on the inside. At present, the Massachusetts Institute of Technology (MIT) in the United States holds the world record (35.2 tesla) for a magnet that generates a constant, strong magnetic field. A strong magnetic field is used to assess the strong magnetic field characteristic of new superconducting oxides with high critical temperatures. Additionally, broad applications are expected, such as for biological and electronic research as well as in the creation of new materials.

An 80 tesla class long pulse magnet and other magnets in the class of the most powerful in the world have been installed at NRIM's strong magnetic field station for comprehensive research on the use of these strong magnetic fields. The 40 tesla hybrid magnet, which is currently NRIM's target for completion, is also one of these magnets. Its unique feature is that it can continuously generate and then maintain a strong (40 tesla) magnetic field. The 80 tesla level is the highest in the world for magnets that generate magnetic fields by pulse. NRIM already has succeeded in generating 74 tesla for a few milliseconds, and holds the world record. (Extracted from *Kagaku Kogyo Nippo*, 28 March 1995)

Rechargeable lithium battery

Most of the tiny button-shaped batteries we use are lithium batteries, and despite their small size they produce an output voltage of 3 V. A recent report in *Nature* describes the development of a rechargeable lithium battery with a composite organic cathode based on a mixture of polyaniline and a dimercaptan derivative. Intimate mixing of these two components is crucial for their synergetic improvement of battery performance, and is easily achieved by casting them jointly from solution. The resulting electrode can be repeatedly charged to near its theoretical limit and discharged. In combination with a lithium counter-electrode and a polymer electrolyte, this provides a light-weight battery that competes favourably with commercial products and shows a promising average discharge voltage (3.4 V) and energy density for the composite cathode. Though the battery may be recharged

up to 30 times, lifetimes are hampered by inactivation of the lithium anode. Also, the current density of the composite cathode still needs improvement. (Source: *Chemistry & Industry*, 3 April 1995)

New material for touch screens

Idemitsu Kosan of Japan has developed a metallic material that can be used to form a transparent electrode coating on plastic film at room temperature. While using existing film manufacturing technology, this will lead to mass production of low-resistance transparent conductive film with stable conductivity and, when used in touch screens or liquid crystal display equipment, it will improve responsiveness and reduce weight substantially. In the near future, the company plans to begin sending samples of the transparent conductive film especially to electronic equipment manufacturers and start conducting business.

The new transparent electrode material is a layered structure compound with a hexagonal crystal base composed of indium oxide and zinc oxide. It was independently developed by Idemitsu Kosan's R&D department and was put to practical use as a functional metallic oxide in the course of research on catalysts for petroleum-related products.

The new material can apparently be made with the existing film manufacturing technology of sputtering at room temperature. Furthermore, because the film itself is non-crystalline, its surface resistance values will not be changed by bending even when it is used for conductive film; and it apparently has one half the resistance of existing transparent conductive film. Material cost will be 50 per cent. higher. (Extracted from *Nikkan Kogyo Shimbun*, 30 March 1995)

Osaka National Research Institute develops titanium nitride ultra-thin conductive film

Japan's Government Industrial Research Institute (GRI), Osaka, of MITI's Agency of Industrial Sciences and Technology (AIST), has succeeded in developing a titanium nitride superconducting film. By using its own thin film formation method, which combines vacuum vapour deposition and ion beam irradiation, GRI Osaka achieved a thickness of 17-20 nanometres, which is thinner than the wavelength of visible light, and so was able to make it transparent. Transparent conducting film made of indium tin oxide (ITO) is already in use, but is chemically unstable and requires a protective film. Because titanium nitride is chemically stable, GRI Osaka hopes that transparency will expand its application as a new optical base material.

GRI Osaka has succeeded in making a continuous, superconducting film out of titanium nitride by applying a dynamic mixing method that it developed on its own. This method uses simultaneous vacuum vapour deposition and ion beam irradiation, and has the unique features of crystal orientation controllability and superior adhesiveness. The process entails using electron beam heating of titanium vapour in a crucible and deposition onto a substrate, and then irradiation with a nitrogen ion beam.

GRI Osaka says that the key technology in this method is ion beam irradiation. Conductivity was not demonstrated by thin film formed by vapour deposition alone and, when left in the open air for a day, the film tended to oxidize, and its translucence was that of titanium oxide. Furthermore, titanium nitride can be formed onto other transparent substrates because it has excellent adhesiveness.

Transparent conducting film made of ITO is being used as electrode material for liquid crystal displays, but it is chemically unstable and requires a protective film, which limits its range of application. The titanium nitride superconducting film developed by GIRI Osaka cannot be substituted for ITO because its surface resistance is too high, but application as an optical base material, such as for cathode ray tube surface processing, can be expected. (Source: *Kagaku Kogyo Nippo*, 22 March 1995)

Blue light emission from GaN LED

EMCORE Corp. (Somerset, NJ) has announced the first growth of blue LED quality material in a manufacturing scale, multi-wafer MOCVD tool. Bright blue LEDs are of great interest today since, when combined with green and red LEDs, they enable the production of full colour (including white) displays. Although blue LEDs have been previously reported, most notably by Nichia Chemical, EMCORE is the first to produce them on production scale equipment.

The GaN epitaxial material was grown on a sapphire substrate at EMCORE's Research Laboratories, using the company's standard Discovery 180 GaN MOCVD system, capable of processing 6 x 2 in. or 3 x 3 in. wafers/run.

Both p-type and n-type layers were grown at EMCORE. The former have shown carrier concentrations up to $5 \times 10^{18}/\text{cm}^3$ with hole mobilities of $20 \text{ cm}^2/\text{Vs}$. These data are significant since both are higher than have been reported by other groups globally working with the MOCVD technique. The room temperature light emission wavelength from the LED was close to 400 nm. (Reprinted with permission from *Semiconductor International Magazine*, May 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA.)

Low-g accelerometer introduced by Analog

Analog Devices (Norwood, MA) has introduced the industry's first single-chip integrated low-g accelerometer, fabricated with standard integrated circuit process technology.

This new chip can resolve minute changes in acceleration, from 0 g to ± 5 g full scale, with 0.005 g resolution, 10 times more precise than the company's ADXL50 ± 50 g airbag version. The chip contains a tiny micromachined sensor, modulator, demodulator, voltage reference, signal conditioning, amplification and on-command self-test circuitry.

The low-g accelerometer, the ADXL05, has applications in automotive, industrial and commercial situations where tilt, inertia, shock, vibration, velocity and acceleration characteristics must be measured. These include virtual reality headsets, machine health monitors, seismic instruments, medical diagnostic equipment, automotive anti-lock brakes and suspension control, and embedded shipping recorders. The chip is also low cost, with a price of \$9.95 for 10,000 piece quantities. (Reprinted with permission from *Semiconductor International Magazine*, April 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA.)

Low temperature, low pressure diamond thin film synthesis

Professor Akio Hiraki and his group at the Faculty of Engineering's Electric Engineering Department, Osaka University, have successfully synthesized a diamond thin film at low temperature and under low pressure. A large

device of 10 microns in thickness and 10 cm^2 ($10 \times 10 \text{ cm}$) was produced by the magnetic field activating plasma chemical vapour deposition (CVD) method at 100°C and under 1/1,000-1/10,000 atmospheric pressure. The crystal growth speed reached 1 micron per hour. The crystal growth was made possible by controlling the temperature and pressure and by creating a magnetic field as well as converting hydrogen to non-thermal equilibrium plasma using plasma. Diamonds are superior in thermal conductivity and have a high energy gap. Therefore, a lot of attention is being paid to their use in environmentally resistant semiconductor devices which are used under exposure to radiation. The new development represents progress towards practical application. (Extracted from *Nikkan Kogyo Shimbun*, 16 March 1995)

Manufacture of ferroelectric material

Kojundo Chemical Laboratory Co. Ltd. has established a technology to produce high-purity ferroelectric material (brand name Y-1) with stability, which is attracting interest from the semiconductor industry for application to the manufacture of non-volatile memories. Up to now, the purity of ferroelectric material had been 99.9 per cent at best, manufacture had been unstable, and the yield rather poor.

Y-1 is a material that was developed by a US venture enterprise Symetix Inc. in 1993, and is attracting the attention of Japanese and US enterprises as a so-called ferroelectric material that retains its electrical charge even after the electric power is cut off.

The material was developed to form oxide films of optional composition by the LMCVD, spin coating, or dip coating methods and, compared with materials developed up to now, features a longer service life as a coated material. The solvents in the coating material are discharged into the atmosphere when in long contact with the air, so that reaction probably proceeds under the influence of moisture in the atmosphere. The material is used wherever possible in an inert or adequately dry environment.

The company concluded a technical cooperation agreement with the US company in February 1994, and established high-purity manufacturing technology based on the manufacturing specifications supplied by the US company. As a result, whereas the purity level had been 99.9 per cent up till now, the purity has been improved to as high as 99.9999 per cent. At the same time, whereas the manufacture of the material had been unstable and often ended in failure, a technique was established for manufacture with stability and at a high yield.

An excellent ferroelectric material is indispensable for producing large-scale capacity non-volatile integrated memories. The establishment of the high-purity ferroelectric material has paved the way for the commercialization of large-scale capacity 256-kb non-volatile integrated memories. Further details from Kojundo Chemical Laboratory Co. Ltd., 5-1-28, Chiyoda, Sakado City, Saitama Pref. 350-02. Tel.: +81-492-84-1511, Fax: +81-492-84-1351. (Source: *JETRO*, May 1995)

LCVD used in rapid prototyping of complex lattices

For the first time, laser-assisted chemical vapour deposition (LCVD) has been used for the rapid prototyping of complex lattice structures with micrometre resolution.

Using two argon-ion laser beams to sustain a vapour-phase chemical reaction, material is deposited in a reaction

zone defined by the intersection of the beams. Only at this combined focus is the energy sufficient to allow deposition.

Fibres with diameters less than 20 microns are fabricated by pulling the substrate holder away from the stationary intersection of the two beams, allowing new material to be deposited on the fibre top at a linear growth rate of roughly 80 microns/s.

Olaf Lehman and Michael Stuke of the Max-Planck-Institut für Biophysikalische Chemie in Göttingen, Germany, use an atmosphere comprising trimethylamine alane (TMAA) and oxygen or N₂O to fabricate complex aluminium oxide rod microstructures.

A substrate holder is fixed inside the deposition chamber and moved slowly in a given spatial direction; new material is deposited as a rod pointing in this direction. Rod "crossings" are possible by starting deposition on an already existing rod rather than directly on the substrate.

Localized laser heating of the aluminium oxide structures in a pure TMAA atmosphere coats the rods smoothly with aluminium. This allows integration of conducting and insulating parts on the same microstructure.

Lehman and Stuke claim that "almost any three-dimensional structure consisting of arbitrarily formed rod segments can be generated". (Source: *Opto and Laser Europe*, May 1995)

New printed circuit wafer for low-cost multi-chip modules

Ibiden Co. Ltd. has developed a new type of printed circuit wafer for multi-chip modules (MCM) which can mount numerous semiconductor chips at high density.

Semiconductor chips are usually mounted on printed circuit wafers sealed inside plastic or ceramic packages. In contrast, the MCM is a method of mounting numerous transistors naked on a printed circuit wafer. Mounting these transistors naked shortens the wiring lengths, with the result that mounting is faster and the information processing speed also increases. At present, the thick film multi-layered ceramic printed circuit wafer is most widely used.

The new MCM-D wafer is made of a copper plate of high thermal conductance, over which are formed thin-film multi-layered circuits mounted on an inexpensive plastic PGA (P-PGA). The thin-film parts and P-PGA are connected electrically by wire bonding. At the central part of the P-PGA is a pierced heat discharge hole that enables heat discharge with the P-PGA faced down. In addition, the use of P-PGA for input/output (IO) enables mounting on the motherboard with ease, while parallel processing of P-PKG is possible. This shortens the development period. Further details from Ibiden Co. Ltd., 2-1, Kanda-cho, Ogaki City, Gifu Pref. 503. Tel.: +81-584-81-3111. Fax: +81-584-81-4676. (Source: *JETRO*, May 1995)

Tantalum nitride barrier material for copper printed circuits

Prof. M. Murakami and T. Oku of the Faculty of Engineering, Kyoto University, have developed a tantalum nitride barrier material for copper printed circuits that is indispensable for manufacturing next-generation Gbit class large-scale integrated silicon semiconductors.

To manufacture Gbit class semiconductors, the 0.15- μ m design rule demands the preparation of thin films of low electrical resistances to produce circuit wiring. Copper wiring is attracting attention because of the excellent

electrical characteristics, and because copper is known to be dispersed inside silicon wafers and cannot therefore be used intact at present. The research team introduced tantalum nitride as a new material to produce thin films by micro-fabrication and used the material to engrave copper wiring on silicon wafers, confirming that a barrier material can be produced with a thickness of 8 nm, or one tenth compared to before, and capable of withstanding a temperature of 700° C for 30 min.

The semiconductor memory was initially produced as 16-Mb chips, but subsequently 64-Mb, 256-Mb and now 1-Gb chips are being made.

The research team studied the feasibility of using tantalum nitride as an insulation barrier between the silicon wafer and copper wiring. The tantalum nitride thin film is produced by first placing an n-type silicon wafer and tantalum in an environment consisting of 1:4 nitrogen and argon, then vapour deposition of tantalum with an ion beam, to produce the film. Copper of 50-100 nm is laminated on the film, and the chip heated for 30 min. at 500-900° C. Further details from Kyoto University, Dept. of Materials Science and Engineering, Yoshidahoncho, Sakyo-ku, Kyoto City, Kyoto 606-01. Tel.: +81-75-753-5466. Fax: +81-75-753-5478. (Source: *JETRO*, May 1995)

Single electron transistor

The Electrotechnical Laboratory of the Agency of Industrial Science and Technology has established a 10-nm rule supermicrofabrication technique applying the STM assisted anodization process, and succeeded in developing a single electron transistor capable of passing electrons individually at room temperature.

The single electron transistor is the basic element of electron number control devices such as logical elements and memory elements in which the number of electrons is controlled accurately, and will become indispensable beyond the year 2010.

The Electrotechnical Laboratory established the world's first supermicrofabrication technique that actually enables the manufacture of electron devices. This technique locally oxidizes titanium metal using an STM to form a fine titanium oxide wire with a width of about 10 nm, which serves as a barrier for electrons. By utilizing the characteristics of this fine titanium oxide wire, a superminuscule tunnel junction structure with a size of 2 nm x 30 nm was fabricated, difficult to achieve by existing lithography techniques, and a single electron transistor was produced.

Current-voltage measurement of the prototype element at room temperature demonstrated the Coulomb staircase in which the current is increased cyclically in stages, and confirmed that this is usable for counting electrons individually at room temperature. The structure of this single electron transistor will become the basic structure of electron number control devices, and is certain to undergo considerable progress in the future. Further details available from Electrotechnical Laboratory, AIST, 1-1-4, Baien, Tsukuba City, Ibaraki Pref. 305. Tel.: +81-298-58-5309. Fax: +81-298-58-5349. (Source: *JETRO*, May 1995)

Power consumption of CMOS circuit halved

Toshiba Corporation has succeeded in halving the power consumption of low power consumption complementary metal-oxide semiconductor (CMOS) chips by lowering the working voltage of transistors from the present voltage level of 3.3 V to 2 V, while a newly

devised low power consumption circuit has been incorporated in the chip. Applying the new technology to the processors of portable information processing terminals (personal digital assistants, PDAs) will extend battery life considerably.

However, to change the wafer voltage, a separate power unit is required, so to apply the new technology to PDAs, a special-purpose power unit will have to be incorporated in the wafer. The company is presently continuing research to develop a built-in power unit. Further details from Toshiba Corporation, Public Relations Office, 1-1-1, Shibaura, Minato-ku, Tokyo 105. Tel.: +81-3-3457-2100, Fax: +81-3-4776. (Source: *JETRO*, April 1995)

World's first successful electricity transmission test using high T_c superconductor

Chubu Electric Power announced in 1995 that, jointly with Sumitomo Electric Industry, the company successfully completed the world's first "sectional electric transmission test" (a test of transmitting 200 amp. current under the condition of 45 kV) of a high-temperature superconducting electric transmission system. The test results showed that they successfully dealt with the following two problems which normally occur when using superconducting cables in practical situations: (1) a cooling technology designed to maintain superconducting state; and (2) making a connecting part of an electric transmission cable end small. They claim that as a result of the successful test, commercialization of high-temperature superconducting cables capable of transmitting a large amount of electric power is not far away.

When transmitting electric power from a substation to a consumer, loss of current is bound to happen in the course of the transmission. If superconducting technology is incorporated, then electric resistance will be reduced substantially, which in turn makes possible the use of thinner cables, less complicated receiving facility, and smaller scale transmission facility. However, since the superconductor, even if a high-temperature type, is not usable unless the temperature is maintained at -196° C, practical electric cable had not been within reach. (Source: *Nikkan Kogyo Shinbun*, 23 March 1995)

New type of micro frictional force measurement system

Prof. K. Ito and his research team of the Department of Precision Mechanics, Faculty of Science and Engineering, Chuo University, have developed a frictional force measurement system featuring excellent resolution and high-speed response.

The system enables frictional forces to be read out at a resolution from several dozen to 100 times better than that of its conventional counterparts, and a fast response that enables observations to be made in split-second time units which are over 10 times shorter. The system incorporates a non-contact displacement sensor developed by NTT Corp.

Research on micromachines is being advanced actively today, making it necessary to elucidate the frictional magnitudes and frictional phenomena occurring in minuscule domains.

The new system consists of a force sensor for measuring the frictional force and a micro-shift stage driven by a piezoelectric tube actuator for moving the specimen. The force sensor is fixed at the terminal of a flat leaf spring and inscribed with contact points, and the

displacement of the leaf spring is measured with a coupled cavity laser displacement sensor and converted into force magnitudes. The displacement sensor is capable of reading out displacements in units of 1 nm.

Observations with greater time resolution allowed continuous observations of the static frictional forces (the forces impressed when starting out from standstill) and the kinetic frictional forces (the forces impressed during motion and sliding). Further details from Chuo University, Faculty of Science and Engineering, 1-13-27, Kasuga, Bunkyo-ku, Tokyo 112. Tel.: +81-3-3817-1819, Fax: +81-3-3817-1820. (Source: *JETRO*, April 1995)

Super high-density magneto-optical disk

Brother Industries Ltd. has developed a super high-density magneto-optical disk featuring a new construction which can store 4-8 times the capacity of information stored by current magneto-optical disks available on the market.

Fierce competition is being waged among disk manufacturers to develop magneto-optical disks of ever higher recording densities in the face of the wide use of personal computers. The new disk has a size compatible with existing personal computers (diameter 3.5 in.) and the storage capacity has been increased to 1 Gbyte. This recording capacity is equivalent to several hundred to 1,000 floppy disks, and is ideal for use in the recording of dynamic information in the multimedia age.

The magneto-optical disk is a recording medium for information storage and retrieval by using a finely tuned laser beam. Big demand for the disk began in the year before last for use in the preservation of personal computer image data or as a backup medium for hard disks.

The new disk uses glass in place of the polycarbonate wafer to enable groove elimination, and instead uses metal chromium in spiral form for use as the guide. The recording material and others are the same as those of the conventional disk. To increase the magneto-optical disk storage density, the widths of the tracks for information recording must be narrower, but with the existing system of forming grooved wafers by injection moulding, it is quite difficult to produce tracks with a pitch of less than 1 μ m.

The new disk poses no problem since it is produced by lithography (superfine engraving technology) that is used in the manufacture of semiconductors, and the company has already fabricated a magneto-optical disk for personal computers with a track pitch of 0.85 μ m and a recording capacity of roughly 500 Mbyte. The disk can be improved further to enable the track width to be narrowed down to as fine as 0.69 μ m to enable recording of 1 Gbyte of information. Further details from Brother Industries Ltd., 15-1, Naeshiro-cho, Mizuho-ku, Nagoya City, Aichi Pref. 467. Tel.: +81-52-824-2511, Fax: +81-52-824-2777. (Source: *JETRO*, April 1995)

High-performance frame buffer memory for three-dimensional graphics

Mitsubishi Electric Corporation has developed the first high-performance frame buffer memory 3D-RAM for use in three-dimensional graphics.

Three-dimensional information is displayed on a two-dimensional screen, so each pixel possesses focal point-based depth information as well as colour information. Therefore, in three-dimensional graphics, it will be necessary to process and rewrite the images including the

colours to make read-out data appear as three-dimensional images on the two-dimensional screen. With the conventional type of frame memory, two separate operations were necessary, one for reading out the three-dimensional exposed data, and another for processing and storing these data, which had posed a bottleneck to the progress of three-dimensional graphics.

The new frame buffer memory incorporates a pixel arithmetic logical unit in its frame memory for performing exposure processing that is basic to three-dimensional graphics, with the result that only write-in will suffice for data exposure which had previously required both data read-out and write-in with the conventional frame memory, by which the performance has been improved by about 10 times. Further details from Mitsubishi Electric Corporation, Public Relations Dept., 2-2-3, Marunouchi, Chiyoda-ku, Tokyo 100. Tel.: +81-3-3218-2172. Fax: +81-3-3218-2431. (Source: *JETRO*, April 1995)

Magnetic microcapsule display sheet

Chemitech Inc., a manufacturer of fine chemicals, has started marketing a newly developed writing sheet called Wonder Capsule Sheet that enables characters and pictures to be written and erased freely and is usable semi-permanently. Microcapsules packed with magnetic powder are processed into sheet form to enable characters, for example, to be written or erased with a magnetic pen or a magnet.

The ordinary microcapsule has a diameter of about 1 μm and is about 1 mm long, and is usually filled with ink for use on non-carbon paper. The new product uses a microcapsule which has a diameter of about 500 μm and is filled with a black superfine magnetic powder, a white pigment, and other additives. These capsules are aligned uniformly to a thickness of 0.5 mm on a plastic film, and covered with another plastic film to form a sheet.

When a magnetic pen is moved over the surface of the plastic film, the magnetic powders inside the capsules are attracted to near the surface to generate a black imprint. The imprint is erased by sliding a magnet along the sheet backside. These operations can be repeated, so the sheet is usable semi-permanently. Compared with conventional types of writing boards, no ink, carbon, or chalk are required, so no powder or dust is generated, the hands and clothing are not soiled, and there is no need for consumables such as pen or paper. Further details from Chemitech Inc., Public Relations Dept., 2-8-33, Wakamatsu-cho, Fuchu City, Tokyo 183. Tel.: +81-423-69-9111. Fax: +81-423-69-0077. (Source: *JETRO*, April 1995)

Roll-up reflection-type polarized screen for liquid crystal projectors

Toppan Printing Co. Ltd. and Sharp Corp. have jointly developed a roll-up reflection-type polarized screen for liquid crystal projectors.

The liquid crystal projector market is expanding steadily due to picture quality improvement through better projector performance, together with miniaturization and price reduction, and the demand for pictures with ever larger screens.

The newly developed polarized light screen is made of a special type of reflection-type substrate material produced in a thin sheet that displays the same performance as the fixed type while retaining flexibility by applying the lamination technology. As a result, when not in use, the

screen can be rolled up in a container fixed to a wall, so not much space is necessary. Also, a stand allows the screen to be portable. Further details from Toppan Printing Co. Ltd., Public Relations Dept., 1, Kanda Izumicho, Chiyoda-ku, Tokyo 101. Tel.: +81-3-3835-5630. Fax: +81-3-3837-7675. (Source: *JETRO*, April 1995)

CNR produces high energy, less polluting batteries

High energy batteries that are more powerful and less polluting than those generally used for personal computers, cellular telephones, recorders and video cameras have been developed in Italy at the CNR (National Research Council) Centre for Electrochemistry and Interphase Chemistry in Rome. The project, which was launched in 1994, has been developed within the framework of the CNR-targeted project on light batteries for electric cars.

The new batteries have double the energy of traditional nickel-cadmium batteries and are less polluting because they contain no heavy metals such as cadmium. The costs are also encouraging: approximately 17,000 lire per kilowatt hour compared to the 85,000 lire of traditional batteries. According to the project leaders, mass production of the batteries can be achieved in the short term and would lead to eliminating commercial reliance from overseas.

Prototypes of accumulators based on new materials, such as highly crystalline graphites and vanadium and manganese oxides with a high energy and power performance, have also been developed within the framework of the same project. (Source: *ANSASERVICE* Database, 15 March 1995)

Mini alternative for picture tubes

A unique "single monolithic chip" has been developed by an Indian scientist. The miniature chip can be used to create a view screen in computer, televisions and video applications. Magnification of display from this miniature high resolution chip would produce an inexpensive screen which can be mounted on face goggles or on alternative stand-alone apparatus. This invention may soon replace expensive and bulky picture tubes.

Using an optic system, the eye can perceive an image of various screen sizes with these goggles. Viewing wide-screen TV or computer drawings as dual chip to produce a three-dimensional image will also be possible. The goggles, which are cost effective as compared to picture tubes, will also be suitable for portable laptop computers, video systems and video telephones. They can also be operated by a miniature battery or solar cells and do not need any heavy electric supply.

The invention, which has been awarded a US patent, is likely to cause a crash in the prices of televisions and picture tubes and screens. (Source: *Tech Monitor*, March-April 1995)

Low-power consumption colour TFT LCD

Sharp Corporation has established a technology that drastically reduces the power consumption of the colour TFT LCD. This leading-edge technology reduces power consumption in 8.4-inch displays from 3 W for conventional models to 1 W. Moreover, the new LCD panels are thinner and lighter than previous models. The displays are energy-saving and space-efficient, yet highly reliable and feature exceptional operability, enabling them to be incorporated into a wider range of portable AV and multimedia devices.

This new power-saving technology significantly extends the operating times of portable devices. For example, notebook-type PCs with an 8.4-inch TFT LCD and 3 W power consumption have a battery life about 1.6 times that of conventional displays.

The company plans to introduce this low-power technology to 10.4-inch models, which are large and easy to view. This is the major display size for multimedia personal computers and for AV devices, such as Sharp LCD ViewCams. Further details from Sharp Corporation, Corporate Public Relations Div., 22-22, Nagaike-cho, Abeno-ku, Osaka 545. Tel.: +81-6-621-1221, Fax: +81-6-628-1653. (Source: *JETRO*, April 1995)

Three types of optical control FETs

K. Shimomura and his research team of the Electrical and Electronic Engineering Department, Faculty of Engineering, Sophia University, have successively developed three types of optical control field effect transistors (FETs).

The optical control FET is a device for converting light into electric signals, and is used as a logical chip. Of the

three new devices, two are structured on a gallium-arsenide (GaAs) wafer, and one on a silicon wafer. These FETs are capable of switching electric signals ON-OFF when a laser beam is irradiated at the gates, so feature device characteristics which are theoretically predicted. The plan is for further research with the aim of further improving the performances.

The GaAs devices have a GaInAs light absorption domain that is operated with light of 1.55 μm wavelength. One utilizes the "direct wafer bonding technique" that is applied in the process of semiconductor laser manufacture, while the other utilizes a polyamide and silicon oxide insulation layer for linking the gates.

The silicon FET incorporates a GaInAsP InP quantum well structure enabling easy absorption of light energy of 1.47 μm in the gate part. All existing devices are made of silicon, and so enable monoblock assembling with ease. Further details from Sophia University, Faculty of Engineering, 7-1, Kioi-cho, Chiyoda-ku, Tokyo 102. Tel.: +81-3-3238-3422, Fax: +81-3-3238-3321. (Source: *JETRO*, April 1995)

D. MARKET TRENDS AND COMPANY NEWS

Market Trends

Annual forecast for fab materials

The annual presentation by Dr. Daniel Rose of Rose Associates (Los Altos, California) to attendees of the 1995 Industry Strategy Symposium (ISS) included a comprehensive forecast for silicon wafers used in semiconductor manufacturing.

	Actual	Est.	Forecast		
	1993	1994	1995	1996	1997
Japan	987	1105	1193	1312	1440
North America	690	793	888	985	1104
Western Europe	239	298	339	374	411
Korea	180	260	325	390	468
ISH (1)	111	114	164	187	215
ROW	89	93	98	103	111
Total	2296	2693	3007	3351	3749

(1) Taiwan + Singapore + Hong Kong
Revised 10/94 (Source: Rose Associates ISS)

	Actual	Forecast		
	1994	1995	1996	1997
Silicon wafers	5102	5713	6134	7294
Other substrates	309	327	353	382
Photomasks	1065	1040	1065	1100
Photoresists				
Positive	290	301	313	323
Negative	14	12	10	8
Advanced	110	122	135	153
Ancillaries	220	246	276	306
Wet chemicals	501	531	563	597
Gases	900	952	996	1041
Deposition materials	267	287	314	344
Total	8778	9531	10459	11548
% growth	11.1	8.6	9.7	10.4

Rose told ISS attendees at the January meeting in Monterey, California. "As 200 mm wafers enter full volume production in new factories around the world, their consumption is on a steep growth". Rose predicts something over 300 million square inches of 200 mm silicon being consumed in 1995, perhaps quadrupling by 1998. By contrast 150 mm wafers are still growing, but will likely peak within the next three years at just under 2,400 million square inches.

"Strong demand for 200 mm has created a squeeze between supply and demand. Based on recent WSTS semiconductor forecasts, we see that a slight shortage of these wafers will continue through 1997", said Rose. Relief should come, however, because "wafer suppliers are pouring on the capacity, and have announced investments totalling over \$1.5 billion within the last six months", he said. (Reprinted with permission from *Semiconductor International Magazine*, April 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA)

Optical disc drive growth

World-wide sales of optical disc drives and media will more than quadruple from \$2.6 billion in 1993 to \$11.5 billion by the year 2000: a 24 per cent compound annual growth rate. Unit growth is expected to be even greater at 44 per cent CAGR, according to a study released by Frost & Sullivan.

As of 1994, CD-ROM accounted for 96 per cent of market revenues and rewritable drives and media 4 per cent, says the report. (Source: *Electronics Weekly*, 3 May 1995)

Equipment benefits from chip demand

Huge demand for semiconductors is fuelling sales of semiconductor equipment as major chip firms scramble to add production capacity, according to the Semiconductor Equipment and Materials International (SEMI) organization.

SEMI reports a book-to-bill ratio of 1.27 for March 1995 representing a 60 per cent increase compared to last year and passing the \$1 billion figure for the first time.

The Semiconductor Industry Association (SIA) predicts continuing strong demand for chips and says that the world-wide semiconductor market will exceed the \$200 billion mark within three years from its current level of \$101.8 billion. The SIA predicts double-digit growth for the next three years.

The North American market will be the largest single market increasing by 35.1 per cent this year, followed by Japan, growing by 44.9 per cent this year. The Asia-Pacific market will grow 49.2 per cent in 1995, while the European market is predicted to grow 37.3 per cent this year. (Extracted from *Electronics Weekly*, 24 May 1995)

Silicon producers achieve record sales for 1994

As the investment in semiconductors continues to shift from 6-inch to 8-inch wafers, demand for high purity silicon for use in semiconductors is rapidly increasing. Thus record sales were achieved in 1994, with the total amount of sales by nine leading companies exceeding \$290 billion.

Supported by the 1994 total sales, the industry, whose earnings had remained in the minus column for several years, finally turned the corner, and even though "1994 was a break-even year" (Japan Society of New Metals), prospects of the industry's profitability are excellent.

According to the production statistics compiled by the Japan Society of New Metals, the amount of single crystals produced in 1994 was 2,808 tons, a 20 per cent increase over the 1993 figures, "far exceeding the initial projection" (Japan Society of New Metals). Continuing this good performance, an upward curve of a 12 per cent increase, or a total output of 3,250 tons, is predicted for 1995.

The breakdown of the total production is as follows: for 1994, the main product was 6-inch wafers "of which over 40 per cent was for domestic consumption" (Japan Society of New Metals), and for 1995, stepped up investment to bolster 8-inch wafer production played a key role. Such silicon crystal makers as Shin-Etsu Handotai, Sumitomo and Komatsu Electronic Metals all made a move to step up their investments.

Increase in sales of single crystals was most noticeable in the area of exports. In monetary terms, 1994 showed an increase of 66 per cent over 1993, and for 1995, an increase of 30 per cent is forecast. The cause of lower growth rate for 1995 lies in "the increase in the amount of 8-inch wafers produced at the companies' US sites, which caused exports to fall off" (Japan Society of New Metals). (Source: *Kogyo Shimbun*, 30 January 1995)

Samsung sales hit billion dollar mark

Samsung Semiconductor grew an astounding 98 per cent in the European semiconductor market last year according to figures released by Dataquest.

Fuelled by a sharp increase in demand for DRAM devices, the Korean semiconductor giant posted European sales of \$1 billion against \$510 million in 1993.

The other big gainers were also DRAM suppliers. NEC grew sales 60 per cent from \$695 million to \$969 million in 1994 and IBM Microelectronics grew 72 per cent to \$705 million from \$409 million.

In the top 10 Siemens grew 34 per cent to \$1.38 billion from \$1.03 billion and Toshiba advanced by the same percentage to \$772 million from \$577 million.

MOS memory demand grew over 60 per cent and MOS microprocessors grew 32 per cent. The surprise was optoelectronic devices which grew over 50 per cent on demand from communications equipment makers.

The EDP sector, with PC makers dominating European semiconductor demand, was nearly 50 per cent.

Communications takes a 25 per cent share. The fastest growing application in 1994 was transportation which, says Dataquest, will grow at a 17 per cent CAGR from 1994 to 1999. (Source: *Electronics Weekly*, 24 May 1995)

Russia, Eastern European semiconductor industries now viewed as devastated

From its "Status 1995" report on the integrated circuit industry, Integrated Circuit Engineering (ICE, Scottsdale, Arizona) presents a devastated view of the industry in Russia and Eastern Europe. This information was contributed to ICE's report by Future Horizons (Kent, England).

The conclusion is that while it may be difficult to think of Russia and Eastern Europe as a "rest of world" region, in terms of microelectronics, that is just what it is.

At its 1989-90 peak, total semiconductor consumption in the region reached \$2 billion with almost 60 per cent of the total output destined for military-related products. Virtually all of this product was produced primarily in Russia and Belarus.

Now, with the collapse of communism in 1989 and the new planned economic system, a deep recession has gripped the region; semiconductor output in 1994 only reached about \$500 million.

With the exception of the Russian Federation, to a lesser extent Belarus and the former East Germany, and more recently, the Czech Republic, virtually all indigenous semiconductor production has ceased or been reduced to pilot production levels.

For example, Microelectronica, Bulgaria's main semiconductor manufacturer and one of the best facilities in Eastern Europe, is currently reduced to pilot line production only due to lack of orders. In the past, Microelectronica, which is capable of producing a full range of devices, was often used as a foundry for Soviet IC production.

In addition to a virtual collapse of local market demand, East European semiconductor device manufacturers face a further challenge from the three-generation technology gap between current East and West manufacturing technologies. The biggest export success so far has been in rather "low tech" watch and calculator chips to the Asia-Pacific region.

Russia and Belarus, in particular, are attempting to attract investors and promote their products to the outside world, but so far with only limited success. ICE's report states, "Most outsiders are currently content to look on with guarded curiosity at this point, partly due to concerns of political and financial instabilities, but mostly due to business uncertainty. The big Western concerns are the current lack of an internal market and quality-related issues."

The ICE report details other efforts by Western microelectronics companies and briefly profiles most Eastern European semiconductor manufacturers. (Reprinted with permission from *Semiconductor International Magazine*, April 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA)

Company News

Fujitsu strengthens marketing of AP1000 parallel supercomputer

Fujitsu will strengthen its marketing of its "AP1000" parallel supercomputer. The company hopes that introduction of the new model, which contains the newest CPU and provides a fivefold improvement in cost performance ratio, will result in orders for about 32 systems in 1995. The new model is positioned as the main force in its supercomputer lineup, alongside the former "VPP500" supercomputer. The system will be aggressively marketed in both the United States and Asia, through the High Performance Computing Division which was behind US efforts with regard to the parallel supercomputer. Fujitsu's intensified efforts are likely to affect the actions of other Japanese manufacturers.

Since it is difficult to achieve parallel software versions for parallel supercomputers, most applications have been limited to research. Although Fujitsu has focused chiefly on "unit sales" designed for research applications in the past, the company hopes to open the market by converting to a sales strategy and using its HPC Division to provide detailed user support. (Source: *Nikkei Sangyo Shimbun*, 17 January 1995)

NEC establishes parallel processing super-computer centre

NEC has set up a parallel processing centre in its Central Laboratory in Kawasaki. The centre is designed to allow universities and other research organizations to study

the applications technology of the "Cenju-3", a parallel-type processing supercomputer.

The parallel processing centre will serve as the base for research and development of decentralized, parallel processing-type applications software via the Internet, and will promote sales of the Cenju-3 system.

While US manufacturers lead the parallel-type supercomputer business, Fujitsu and Hitachi Ltd. have also become players; market competition is likely to intensify as the use of advanced parallel processing technology becomes more widespread.

NEC set up a predecessor facility for internal use at its Central Laboratory in October 1994. It was then decided to expand this facility and open it up to external users. The facility consists of two Cenju-3 systems, which contain 64 processors each, and one system which contains 32 processors. These three systems can be accessed from the outside via the Internet.

About 32 research organizations in Japan are expected to use the facility, and there are also plans to open up the facilities to overseas organizations before the end of 1995. The NEC "High Performance Computing" (HPC) study group has also been established to enable users to transfer data among themselves regarding the research.

In addition, about 20 Japanese universities will participate in the centre, in the form of the "on-line university project", which will promote research and development efforts for future data communications technologies. As of July 1995 the supercomputer centre will be accessible from a network formed in conjunction with the on-line university project. The Parallel Processing Supercomputer Centre will remain open for three years, until the end of 1997.

The purpose for setting a time-limit is to accelerate research efforts. At present, NEC has received orders for eight Cenju-3 systems. There are another eight units currently being used for research. By opening the supercomputer centre, NEC hopes to generate orders for eight more systems in 1995. (Source: *Nikkan Kogyo Shimbun*, 24 January 1995)

Canon to increase stepper production

This year Canon will increase the production of steppers (sequential motion exposure system) by 60 per cent over last year. The focus will be on advanced equipment for the mass production of 16-Mb (megabit = 1 million bits) to 64-Mb DRAMs (dynamic random access memory which require a memory refresh operation). Existing facilities will be effectively used to pursue Nikon, who started a system to increase production early on and is in the lead.

The number of steppers sold by Canon in 1994 increased 60 per cent over the previous year and the same major gain of a 60 per cent increase is forecast for 1995.

In contrast, Nikon, the leading company, forecasted sales of 410 to 420 devices in 1994, a 20 per cent increase over the previous year, and maintains a positive outlook for the number to be shipped in 1995.

Eying the generation change after 1996, the intensity of the competition to obtain orders between the world's leading two stepper manufacturers will escalate. (Source: *Nikkei Sangyo Shimbun*, 9 January 1995)

Sales soar in Europe's big three chip firms

Europe should have three \$3 billion chip companies by the end of this year as massive growth transforms the semiconductor businesses of Philips, SGS-Thomson and Siemens. They are growing at between 28 and 37 per cent and expect that growth to accelerate.

Philips semiconductor sales amounted to \$1.6 billion for the quarter - a 28 per cent rise on last year's first

quarter. The growth has come as a surprise to Philips which had budgeted for a 15 per cent rise in the semiconductor market this year.

Profits from semiconductors amounted to \$340 million - almost as much profit as the entire Philips group turned in for the quarter.

Siemens' semiconductor sales were up 37 per cent in the first six months of the fiscal year and Siemens confidently expects to outgrow the market by 30 per cent this year.

The company does not release its market forecasts but industry sources in Germany suggest the market there will grow 25 per cent. Siemens' semiconductor sales for the six months were \$1.46 billion.

SGS-Thomson grew its first quarter sales by 30 per cent to \$778 million with profits up 39 per cent to \$142 million.

The company's gross profit margins remain unchanged from last year's impressive 42 per cent. SGS reported that more than half its revenues now derive from outside Europe. (Source: *Electronics Weekly*, 3 May 1995)

Electronics recycling

Seventeen electronics-related companies, including the Bayer Plastics Business Group (Newbury, UK) have set up the Electronic Manufacturers Equipment Recycling Group (Emerg). Bayer, which supplies engineering thermoplastics to electronics companies, says Emerg is "a first step towards establishing an industry-standard recycling solution, which could be reproduced in other regions". The group aims to improve mechanical decontamination of plastics, set up more extensive recycling of printed circuit boards and recycling of cathode ray tubes in TV sets, and possibly build an incinerator for other electronics materials currently landfilled. (Source: *Chemical Week*, 31 May 1995)

Shin-Etsu Handotai to boost output in the USA

The world's biggest semiconductor wafer maker, Shin-Etsu Handotai, will step up the production of 8-inch wafers in the USA. Its plans involve the construction of a single crystal silicon (wafer material) plant and a wafer processing plant, the former starting production in the second half of 1996 and the latter in 1998. The total amount of investment in equipment and plant (excluding land) is estimated at \$700 million. The processing plant is expected to produce 25,000 8-inch wafers a month, more than doubling the present US production capacity, so that the company can meet growing demands from Intel, Motorola and other semiconductor makers in the USA.

The new plant's monthly production scale will be 80 tons of single crystal silicon and 25,000 sheets of 8-inch wafers, which more than doubles the present US capacity in both cases. With the new increased capacity, the company hopes to meet the demands of US semiconductor manufacturer, Microprocessor (MPU), and Japanese makers who are stepping up their memory chip production.

The total output of 8-inch wafers by all wafer makers combined ranges from 600,000 to 700,000, of which Shin-Etsu's share is around 40 per cent. Growing demand for 8-inch wafers throughout the world is tightening their supply.

In addition to Japan and the United States, Shin-Etsu Handotai has factories in England and Malaysia, supplying wafers to local semiconductor manufacturers. In order to meet the growing need of semiconductor makers, the plants both in Malaysia and England are planning for a substantial increase in the 8-inch wafer production capacity.

In the United States, in addition to Shin-Etsu Handotai, Mitsubishi Materials is constructing a new plant in Oregon, aiming for 1996 as a completion date. (Source: *Nihon Keizai Shimbun*, 12 January 1995)

E. APPLICATIONS

Supersensitive metal defect probe system using superconducting magnetic sensor

Chubu Electric Power Co., Inc. and Furukawa Electric Co., Ltd. have jointly succeeded in developing the first sensor system that uses a superconducting quantum interference device (SQUID) for a magnetic probe to detect defects inside metals before cracks are generated.

When metals age or are deformed by a force, the crystal phase metal structures are transformed. The resultant changes in magnetic properties can be utilized to probe for defects. In nuclear power plants and other thermal power plants, metal cracking is a hazard and may culminate in a major accident. The companies observe that the new system will help improve industrial plant reliability.

This probe system uses a SQUID magnetic sensor with a sensitivity 100 times the terrestrial magnetism. The voltage is changed when the outside magnetic field signal is changed with a superconducting ring that is linked to the insulating film, which enables the magnetic change to be measured. The sensitivity is much better than that of ordinary magnetic sensors, but is easily influenced by outside magnetic fields. Therefore, the outer part is covered with a magnetic shield made of a high-temperature superconducting material to shield off extraneous magnetic fields and enable interception of feeble signals.

In experiments, a tensile stress was applied to a stainless steel material and the resultant crystal phase change (transformation from austenite phase to martensite phase) investigated. The structural changes could be detected from a point over 15 cm away from the specimen. This indicates that the internal changes in metals caused by stress can be detected as a magnetic change prior to crack generation or fracture, and that the sensing system is usable as a high-sensitivity non-destructive metal probe system for detecting defects in the early stage before cracks form.

The plan is to accumulate data relating to the type and degree of metal deterioration and to establish a database with the aim of commercializing a probe system usable in power plants. Further details from Chubu Electric Power Co., Inc., Information and Public Affairs Dept., 1, Higashi-shinmachi, Nagoya City, Aichi Pref. 461. Tel.: +81-52-951-8211, Fax: +81-52-953-6202. (Source: *JETRO*, April 1995)

Graphic traffic

The emphasis on graphical user interfaces has focused attention on the display subsystem and its implementation cost. The move to higher screen resolutions at 24 bits per pixel true colour and increased refresh rates to reduce screen flicker demands improved bandwidths and deeper buffers than could be practically or economically provided with the latest generation "vanilla" DRAMs.

The issue is not the storage capacity of DRAMs. As densities reach 64 Mbit and beyond, just one or two chips provide the capacity for most graphics applications. The problem is how to get bandwidths of 500 Mbytes and greater from those one or two chips that have limited I/O.

The outcome is an alphabet soup of new memory variants all claiming to provide the solution. The major categories are, first, the traditional multiport DRAM such as video RAM (VRAM) joined by Windows RAM, 3DRAM and synchronous VRAM. Second, there is the single port RAM types extending from modified DRAM

architectures with 16 or 32-bit I/Os to EDO DRAM, burst EDO, synchronous DRAM (SDRAM), synchronous graphics RAM (SGRAM), synchronous multibank DRAM (MDRAM) and Rambus DRAM (RDRAM).

However, the major contenders are EDO, SDRAM, RDFAM and possibly MDRAM. At present the market for all these types is small but is set to grow dramatically over the coming months as multimedia takes hold in personal computers. The multiport variants seem destined to remain niche players because of their high cost due to the more complex package. VRAM is now three times more costly per bit than ordinary DRAM and, although VRAM continues to offer the highest current performance and demand remains high, most manufacturers do not plan further development. (Extracted from *Electronics Weekly*, 31 May 1995)

Optical pointing system for PC-based presentations

Fujitsu Ltd.'s Personal Systems Research Laboratory has developed a portable input system for personal computers that can be manipulated while walking about. The conventional mouse is used by sliding on the desk, but the new system is a three-dimensional mouse that is manipulated in the air so requires no sliding plane, and incorporates a PSD Position Sensing Detector chip of simple construction and processing to sense light position, so is designed to sense motions optically. This mouse is intended for use in the electronic presentations of personal computer images on a screen.

The new system is the size of a small portable telephone set, slightly heavier than the familiar mouse, but can be manipulated with a single hand. It is linked to the personal computer by wire (developed) wireless (in development) or by a radio circuit and operated in the same manner as a mouse. Further details from Fujitsu Ltd., Public Relations Dept., 1-6-1, Marunouchi, Chiyoda-ku, Tokyo 100. Tel.: +81-3-3213-4160, Fax: +81-3-3216-9365. (Source: *JETRO*, April 1995)

Compact, lightweight digital still camera

Ricoh Co., Ltd. has developed a compact, lightweight digital still camera, Ricoh DC-1 (135 x 22 x 76 mm, 225 g), that records still pictures and can record and play back audio signals and animated images. This is the first digital camera capable of working with animated pictures, and is to be marketed as a simplified commercial tool for the age of multimedia.

This camera records data on a 24-Mbyte PC card, to a maximum of 492 still pictures, or 4 scenes (1 scene 5 s) of moving pictures, or 100 min of audio signals. It can also record a succession of these different data.

The diverse recorded data can be confirmed on the spot with an optional liquid crystal monitor, and playback and printout directly from a TV or video printer are possible from a playback adaptor via an AV cable. In addition, it is possible to output PC card recordings by directly inserting the card in a personal computer PCMCIA slot or RS232C cable through an optional adaptor. Also, using a communication adaptor, it is possible to transmit data from a portable digital telephone with a modem into a personal computer.

The company plans to market the new digital still camera as a part of a lineup of image processing systems (IPS), or as new office automation (OA) systems which integrate computer and communications technologies for integrated processing of image and data information. Further details from Ricoh Co., Ltd., Public Relations Dept., 1-15-5, Minami Aoyama, Minato-ku, Tokyo 107. Tel.: +81-3-5411-4511, Fax: +81-3-3403-1578. (Source: *JETRO*, April 1995)

Highest resolution infrared ray CCD camera

Nikon Corp. has developed an infrared ray CCD camera Thermal Vision LAIRD (Leading Application of InfraRed Detector) 3 that uses the company's 410,000-pixel charge-coupled device (CCD) that features the world's highest resolution as an infrared ray photo-sensitive device.

The camera is compatible with the existing NTSC TV system for taking animated pictures in the same manner as a combination camera-VTR system. The camera is used for non-destructive inspections such as the diagnosis of defects and aged parts, and for temperature observation and medical diagnosis.

Distinct features are the advanced image processing attributes such as the processing of coloured images, a double-sized screen and temperature measurements of up to 16 spots in a given measurement area with a single unit, and remote control of all functions. Another distinct feature is the infrared ray CCD cooling with a Sterling cooler that circulates a helium gas hermetically sealed inside the camera. Further details from Nikon Corporation, Customized Industrial Supplies & Equipment Div., 1-6-3, Nishi-Oi, Shinagawa-ku, Tokyo 100. Tel.: +81-3-5742-1821, Fax: +81-3-5742-1825. (Source: *JETRO*, April 1995)

Low-cost PLCs

The never-ceasing effort to add value to products without adding consequentially to their cost has been facilitated (at least for the makers and users of automatic machinery) by Allen-Bradley Co.'s introduction of its MicroLogix 1000 family of programmable logic controllers (PLCs). Aimed at applications with fewer than 32 input-output ports, the new controllers are small and fast, as well as inexpensive.

The smallest member of the MicroLogix 1000 family measures a compact 120 by 80 by 40 mm and can process a 500-instruction program in less than 2 ms.

Allen-Bradley is supporting the new PLCs with three accessory products: a hand-held programmer (HHP) and two operator interfaces. The programmer is useful for making run-time adjustments as well as programming and editing. It has a carbon-rubber keypad and a two-line, 16-character liquid-crystal display.

The simpler of the operator interfaces, called the MicroView, provides an operator with data-display, data-entry, and recipe download capabilities. In addition to a two-line LCD like the one on the HHP, the MicroView has a numeric keypad and two user-programmable function keys.

The second interface, the DTAM, provides all of the features and functions of the MicroView, but has eight function keys plus alarm functions. (Source: *IEEE Spectrum*, February 1995)

Exerciser plugs holes in PCI system development

Now that much of the computer industry has accepted the Peripheral Component Interconnect (PCI) bus, suppliers

are hurrying to bring PCI-compatible products to market quickly. But sometimes schedules slip because developers must await delivery of certain application-specific chips or other hardware. The E2910A PCI Bus Exerciser from Hewlett-Packard Co. shortens the wait by simulating the bus traffic that the missing device ought to be there to generate.

The E2910A can also act as a bus controller, monitor and recorder. It is, in sum, a general-purpose tool to develop PCI bus products.

Physically, the package consists of a suite of Windows-based system software, three cards, adaptors and assorted cabling. The test sequencer card plugs into a PC; the bus exerciser card plugs into the system under development by means of a choice of adaptors; and an IEEE-488 card connects the PC with an HP 16500A B logic analyser.

The test sequencer card, which runs at up to 33 MHz, controls the bus exerciser card. It allows the user to define complex sequences of transactions, with triggering or branching on system events detected by the logic analyser or by the bus exerciser itself.

The bus exerciser generates user-defined transactions, whether acting as a master or a target. It includes a protocol monitor, which continually monitors 30 PCI protocol rules in real time. If it detects a violation, it generates a signal that may be used for triggering or branching. In addition, the bus exerciser also generates sideband signals synchronized to bus transactions. (Source: *IEEE Spectrum*, March 1995)

Micromachining applications in the auto industry

Micromachining technology started to attract attention as an indispensable technology for size reduction of various sensors in the early 1970s, and was put to practical use as silicon pressure sensor fabrication technology around 1975. The technology has been developed as developments of microfabrication technology of silicon devices such as LSIs into the manufacturing of three-dimensional structure devices, and much is expected for further size reduction and accuracy improvement of functional devices, including actuators as well as sensors. The original missions of these devices are conversion or modulation between physical, mechanical or chemical quantities and electrical quantities, and size reduction and accuracy improvement are also extremely important in their application to automobiles because the size and accuracy effects are reflected directly in the system accuracy and system size and eventually in their performance and costs. If sensors and actuators can be regarded as input/output devices of control and information systems, this technology can be seen as indispensable for improving compatibility with microsystems and promoting integrated and intelligent systems.

For the present, micromachining is mainly applied to physical quantity sensors, particularly to sensors using silicon as the substrate material. This is because the fundamental technologies of micromachining have been developed for silicon devices; a wide range of technologies for processing and device implementation are available; silicon has elastic properties which are indispensable for the materials responding to changes in physical and mechanical quantities; and that there is the possibility to package the required electronic circuitry for converting the detected quantity into an electrical quantity on the same substrate. These reasons have led to the development and practical use of the basic micromachining technology for forming sensor devices using silicon.

The above properties and the possibility of mass production also attracted attention in the field of automobiles, and a silicon pressure sensor was developed and implemented as the sensor for the intake manifold absolute negative pressure for use in detecting the engine load. After this, the increased need for car body control and safety equipment has increased expectations for compact, high-sensitivity silicon accelerometers, which are now in practical use. Both of these sensors use silicon micromachining to form a diaphragm or cantilever which is deformed by a very small force and converts the displacement or internal stress into an electrical quantity.

The advantages of silicon micromachined devices lie in their mass-producibility and cost. Therefore, developments and consequences are also expected in their applications in automobiles. Actuators, such as microvalves, are also being developed although they are not well known as sensors. However, since microstructures are essentially not suitable for producing a large force or torque, they should be applied in automobiles through static microstructure manufacturing technology.

Micromachining technology is not simply technology for sensors, actuators or their combinations and this technology uses more than silicon as the material. In the future age of intelligent vehicles, sensing and information communications technology using light waves, microwaves and millimetre waves will be used frequently. The optocouplers which divide or combine these waves are a typical passive component, while the light wave and millimetre wave phase modulators and circulators are typical active components. Both of these component types present high wavelength and alignment accuracy requirements and the application of micromachining technology is expected. Some examples of applications in automobiles include the optocoupler of the optical fibre gyro used as the inertial navigation sensor of car navigation systems and the transmitter/receiver of collision prevention radar.

The pursuit of multifunctionality and integration of electronic systems makes it indispensable to join or combine functional devices such as sensors and power devices and the intelligent parts such as the electronic circuitry, and this is also desirable for size reduction and the integration of car electronic systems. In particular, integration is expected to progress rapidly in display devices and image sensing, where the combination of sensor elements and intelligent parts is absolutely necessary.

To make use of the advantage in the area of microstructures, it is a matter of course that composite physical structures progress from two-dimensional (linear) to three-dimensional (layer) structures, and the difference in the manufacturing processes of various functional elements make it necessary to perform combination in the vertical direction by stacking functional layers. This has led to progress in the development of technology for layer bonding between silicon materials or between silicon and other materials directly or via an oxide film. This kind of bonding makes possible the multiplication of functional parts into layers and their interconnections, which used to be possible only by the deposition or recrystallization of amorphous or polycrystalline films or by new crystal growth. (Extracted from *Jidosha Gijutsu*, January 1995)

Navigation for cars

A vehicle navigation system developed by Xanavi Informatics, a company owned by Hitachi and Nissan, is

the world's first navigation system with an in-car panoramic view display of the roads

The system consists of a 32-bit CPU and a high-speed image processing unit, which allows a bird-view of the streets, unlike flat-map image displays currently used.

Nissan plans to introduce this system in one of its high-end models. (Source: *Electronics Weekly*, 3 May 1995)

Telephone voice recognition and response system

Mitsubishi Electric Corp. has commercialized and started marketing a system capable of recognizing as many as 100,000 words (simultaneous recognition 1,000 words) spoken over the telephone by non-specific persons.

The development of a system capable of recognizing and responding to voices input through a telephone will enable consultation, ordering, and reservations to be performed conveniently and with ease at any time and from any place, and will allow business operations to be performed effectively with less manpower. However, recognizing the voices of various persons with different vocal characteristics over the telephone is quite difficult.

The new system, MELAVIS, is capable of recognizing the words uttered by non-specific speakers over a telephone, without having to register the user's voice beforehand. In addition, the number of words to be recognized can be set freely by the introduction of a unique phoneme model developed by the company, and the response voice can be recorded and edited on a workstation. In addition, a local-area network (LAN) system enabling the connection of multiple telephone lines is provided as standard specifications (up to 6 channels can be connected to a single system). So MELAVIS is usable for establishing diversified systems with voice recognition and response functions and for incorporation into existing systems with ease.

The environment for system development include utilities for preparing word dictionaries from word texts as well as preparing response voices, a telephone function and a library for controlling question-and-answer sequences. Further details from Mitsubishi Electric Corporation, Public Relations Dept., 2-2-3, Marunouchi, Chiyoda-ku, Tokyo 100. Tel.: +81-3-3218-2172. Fax: +81-3-3218-2431. (Source: *JETRO*, May 1995)

Image recognition system using artificial retina chips

Mitsubishi Electric Corp.'s Semiconductor Research Laboratory has developed a new type of image recognition system that uses artificial retina chips to enable stereoscopic observation of objects in the same way as the human eye. The parallax of images photographed from two points of vision are analysed continuously to instantaneously compute the object shape, position and movement speed. The recognition speed is more than 80 times faster than that of a system using charge-coupled devices (CCD).

The new system consists of two artificial retina chips comparable to the human eyes and an optical neurochip comparable to the human brain. Two video cameras with built-in retina chips are placed slightly apart and the target object photographed. The images captured by these two cameras have different angles of imaging, so are not identical. The optical neurochip analyses the displacement of these two images, and the distance between the cameras and the object are calculated based on trigonometry.

Using the new image recognition system enables facility monitoring, such as confirming whether a factory production line is functioning properly, or the commercialization of a radar system for tracking aeroplanes. In the future, the system can be applied to the development of a robot that performs tasks in outer space or in hazardous places while confirming the surrounding environments where man cannot enter. Further details from Mitsubishi Electric Corporation, Public Relations Dept., 2-2-3, Marunouchi, Chiyoda-ku, Tokyo 100. Tel.: +81-3-3218-2172, Fax: +81-3-3218-2431. (Source: *JETRO*, May 1995)

Use of information technology by biological researchers

Recent studies of computer-based information handling have tended to look across the board at all of science. It was decided that a study of computer usage in biology may help forward planning during a period of considerable change in biological information handling. Four groups of biologists were studied—a university agricultural faculty; a university school of biology; a government research establishment; and a pharmaceutical laboratory. Based on previous surveys, it was decided that the personal characteristics of respondents that were most likely to correlate with information handling were age, highest educational qualifications and position. Respondents were asked to assess their own communication activities, and over three quarters of respondents had produced some kind of publication since 1990. Teaching was highest in the agricultural faculty and higher than expected at the government establishment. Details of communication activities were collected in terms of reading and communicating; level of satisfaction with the provision of research information; restrictions on communication; availability of computers; usage and tasks for which computers are used; online searching and use of online services; and publishing activities.

The results of the survey were compared with the recent Royal Society study, and data compared reasonably well where there was overlap both for general activities and on specific points. There is also general agreement that lack of awareness of information sources is one of the major obstacles to expanding their use. Points of difference were that the pharmaceutical laboratory has a higher level of electronic information than would be expected from the Royal Society results. The Royal Society survey found that most respondents would like to access their library via a workstation, the survey of biologists extended these conclusions as respondents clearly wished to carry out as many activities from their own workstations and accessing, either directly or via intermediaries, all the information services they need. Across the whole range of biological sciences, the differences in computer-based information handling within biology is as wide as anything to be found across science as a whole. Problems of access to information can be as diverse within a single discipline as in a range of disciplines. (Source: *Journal of Information Science*, 21(2) 1995)

Intel core serves I/O solutions

An intelligent I/O processor has been unveiled by Intel to address more exacting applications using present

PC technology, namely x86 microprocessors and PCI local bus.

Advancements in I/O technologies for networking and storage has also increased I/O demands. These include 100 Mbit/s Ethernet and ATM; and for storage the Ultra-SCSI and 100 Mbyte/s Fibre Channel standards.

To address these issues Intel has announced the i960RP. The device is based on its i960Jx core, which is rated at 31 Mips (VAX) at 33 MHz, and includes a 4kbyte instruction cache, and a 2kbyte data cache.

The i960RP is designed to offload the demands placed on the host processor while offering I/O expansion via a secondary PCI local bus. In addition to the core and PCI to PCI bridge, the i960RP features two DMA controllers, address translation units, PCI bus arbitration logic, a memory controller and a I²C interface.

Intel plans to announce further i960 core upgrades and produce other, more tailored product variants. (Source: *Electronics Weekly*, 21 June 1995)

UK system points finger at thieves

To catch a thief, or any other re-offending criminal, can take a matter of minutes with a little help from the UK-based DSP firm, Cambridge Neurodynamics Limited (CNL).

The company has developed a neural network Integrated Automatic Fingerprint Recognition System (IAFRS), that can match a ten fingerprint (tenprint) set to one from a total of a million stored in a central database.

The system comprises an encoder and image analyser, and image matcher, which are linked via a LAN. Once a tenprint has been scanned in, it is stored as a greyscale image in a 40:1 compressed format using C-Cube's CL-550 JPEG device. In order to receive (transmit) noise-free images from (to) remote locations, CNL also executes its proprietary compression algorithms on the images. Techniques such as the wavelet-based modified fast lapped transform encoding, and error resilient entropy coding are used. These avoid blocking artefacts that result from the compression, smoothing away image irregularities and spreading errors throughout the image.

The unit extracts and encodes 16 of the most identifiable physical characteristics of the fingerprint. The unit uses a neural network to extract the statistics from a large-scale image. Neural networks are used because they are seen as one of the best methods of data analysis for poor quality inputs, which can be unclear, smudged or superimposed.

The matcher is based on the same processing board as the encoder, but runs a different algorithm to identify a kilobyte of information with one from a million-image library of fingerprint information. The matching of fingerprints can take 15 minutes on average, whilst the encoding takes approximately one minute per set.

The system, being scalable, can be expanded as required. Currently the IAFRS is being used by the South Yorkshire Police, but its applications go beyond policing. It can be used in ballistics and DNA matching (for which there is currently no extensive database), immigration and passport control, banking and social security applications (Source: *Electronics Weekly*, 21 June 1995)

F. SOFTWARE

Europeans can capitalize on US shortfall

Currently, there is a product vacuum in US information markets and European companies have the opportunity of a lifetime to fill it. It is the glaring absence of an information application: simple point-and-click information retrieval software that allows end-users to answer commonly asked questions about companies, industries and products as easily as they now produce a document in a word-processing program. The information application is a software backwater in North America when compared with other applications programs. Even a simple version of the above tool would open up a vast market of corporate managers, professionals and analysts who need to do occasional searching from office, home or the road; it would also tap into the even larger middle market of smaller businesses and home offices.

For a variety of reasons, North American companies have been late to introduce such applications. Isolated examples exist, notably SandPoint's Hoover product for Lotus Notes and, from the unlikely world of chemical databases, CAS' new intuitive search interface, SciFinder. DataTimes is close to launching EyeQ, a point-and-shoot product aimed at the vast middle market. Other promising products are in development: LEXIS/NEXIS' company Quick-Check, which automates several basic search functions, and Dialog's BusinessBase, a compelling Windows product that automates a number of common company-search tasks. But these efforts are only the first small steps towards the robust applications and low-cost pricing models we will need to help non-professional searchers get answers. (Source: *Information World Review*, May 1995)

Low-cost robot simulation software

Denebu Japan, a robot simulation software developer (Isebara City, Kanagawa Prefecture) has begun the full-scale marketing of its low-cost software which can produce software for robots on personal computers. The price of this software is about one third of the cost for programs that run on workstations (WS), making it possible to sell this software to mainstream mid- and small-sized robot users. They plan to sell 100 copies of this software per year.

In order to utilize robots on small-scale production lines which produce multiple products, "off-line teaching", which produces programs before the fact on simulation software, is indispensable. However, because the cost of WS-use simulation software is around ¥10 million, even though there is wide demand for this software among mainstream, mid- and small-sized robot users, this software has not become widely used in the market.

In light of these conditions, Denebu Japan developed its "Ultra Series" personal computer software line. This series includes four software packages, each of which is a simulation package for one of the four main simulation functions incorporated into the WS software. These four main simulation applications are "arc welding", "spot welding", "painting", and "assembly processing". The cost of this software has been set at ¥3.45 million, about one third of that for the WS software. In the future, this software will meet the latent demand found among mainstream, mid- and small-sized robot users, a group which is

yet to use robotics to its fullest extent. (Source: *Nikkei Sangyo Shimbun*, 10 January 1995)

Fujitsu develops faster CAD software

Fujitsu Ltd. has developed a fast CAD system "Design Theater", capable of reducing by more than 50 per cent the time required by the previous technique for designing high-density printed circuit boards and multi-chip modules. Although the software was originally developed for in-house usage, it will be sold to outside customers. The new CAD system is based on the new technique of using a computer early in the upstream conceptual design stage, where today manual design is normal, to drastically improve the overall design efficiency through the downstream detail design stage. Year after year, components have been mounted on a circuit board with increasing density and complexity, causing a long delay in the design process. The new software is expected to become the next generation's system that can eliminate the delay.

The new system will be sold as a conceptual design package for Fujitsu's printed circuit board CAD "ICAD PCB". The system can be used with the workstation "S Family". Fujitsu hopes to sell 1,000 sets of this system in the next three years. (Extracted from: *Nikkan Kogyo Shimbun*, 2 February 1995.)

Imaging tool extracts forms

Imagine 4.0, the latest version of the custom control imaging package from Imagination Software Inc., adds forms recognition and extraction along with programmable annotations, mark sensing, intelligent character recognition, and colour to the capabilities of earlier versions. A Visual Basic application for scanning, viewing, printing, storing and manipulating images, Imagine is a highly flexible product that is easily customized to individual needs.

Its clean-up feature can de-skew, de-speckle, and de-shade captured images as well as remove lines and other extraneous objects. Its overlay forms feature helps users such as government agencies save storage space by using one copy of a form with many images of data records.

Its new forms features identify forms from images and optionally extract the filled-in information into another image file. The features include provisions for managing forms libraries.

Imagine runs under Windows 3.1 and is compatible with Visual Basic, Visual C++, and Borland C++. It supports over 40 image formats, including JPEG, GIF, TIFF, EMS, BMP, PCX, CALS, and IMG. It can in addition read 12 bar codes, among them: Code 39, Code 128, Codabar, 3 of 5, and 3 of 5 (interleaved).

Imagine 4.0 is priced at \$695 for a single-user licence. Contact: Imagination Software Inc., 8737 Colesville Road, Suite 301, Silver Spring, MD 20910. Tel.: 301-588-8411, Fax: 301-588-1912. (Source: *IEEE Spectrum*, February 1995)

DADISP now does neural nets

Of three new add-on modules for the popular DADISP graphical scientific and engineering spreadsheet from DSP Development Corp., the most interesting enables users to build and run the back-propagation type of neural network. Called DADISP Neural Net, the add-on is a menu-driven

module that could find wide application in such areas as speech and pattern recognition, image processing and cluster analysis. The PC version of DADiSP Neural Net is priced at \$695 for PCs.

The other two modules do signal processing. The first, DADiSP/Filters 3.0, which offers finite- and infinite-impulse response (FIR and IIR) filtering functions, now includes Kaiser window filtering. The module allows both the time- and frequency-domain characteristics of a filter to be displayed and manipulated. The filter coefficients are displayed in a window of their own and saved in a system file for further use.

Over and above designing a host of common filters, DADiSP/Filters 3.0 can calculate and plot the zeroes of an IIR or FIR filter; calculate the group delay of an IIR filter, and perform a variety of conversions from one filter type to another.

Finally, DADiSP/AdvDSP 1.0 performs a variety of advanced digital signal-processing functions—fast Fourier transforms (FFTs), power spectral density estimation, digital interpolation, and cepstrum analysis, to mention a few. It can execute over 20 high-level algorithms, such as chirp Z transforms, zoom FFTs, Yule-Walker linear prediction, and Burg method (maximum entropy) estimations.

DADiSP/Filters 3.0 and DADiSP AdvDSP 1.0 are each priced at \$495 for PCs and \$995 for workstations. Contact: DSP Development Corp., One Kendall Square, Cambridge, MA 02139. Tel.: 617-577-1133, Fax: 617-577-8211. (Source: *IEEE Spectrum*, March 1995)

European Software Quality Initiative

From January 1995 to 15 May 1996, AFNOR is directing France's participation in the ESPITI (European Software Process Improvement Training Initiative) project, a sensitization and training campaign focusing on software quality.

"Software quality is a major concern of executives in the information services profession, as well as a key factor in success", says Jean Hyenne, head of the Information and Applications Technologies service at AFNOR [French Standards Association], the entity responsible for implementing France's participation in ESPITI under the co-ordinating aegis of the Commission of the European Union (DG III [Directorate General for Industry]).

The objective is to enable European software firms to improve their competitiveness by paying more attention to quality issues. It is a part of the ESI (European Software Initiative) software quality improvement program. ESPITI extends over a two-year period. Through sensitization campaigns, and above all through training, it is trying to reach all software producers, especially the small or medium-size enterprises and the information management teams of firms and agencies that place big orders. To ensure Project ESPITI succeeds, AFNOR will work on a study to determine the extent to which the ISO 9000 [Open Systems Interconnection] initiative has penetrated the sector. This study will also facilitate a better understanding and identification of what the market needs in order to master the concepts of quality control.

Finally, AFNOR will direct implementation of the sensitization, training and publication campaigns provided for in the European program. AFNOR's training division will mobilize its regional delegations. Sensitization will take the form of making the information available (via databases and telephonic access), and all of AFNOR's resources will be mobilized to this end.

As a follow-up to the program, AFNOR has plans to assess the impact of its campaign on perceptions and on software development practices, and provide the results to all the players.

Software quality standards already published or currently being fine-tuned cover three broad areas:

- Product quality—defining software quality and guidelines for building quality control into the software development, evaluation and acquisition processes (ISO standard 9126 defines six criteria of quality: maintainability, reliability, ease of use, output and performance, functionalities, and [program or output] portability);
- Engineering quality—defining the characteristic activities of different phases in the life of a software product, and identifying the tools needed to determine when a particular stage in development has been reached;
- Quality of environment—defining the organization structure of software engineering workshops, and setting guidelines for evaluating the quality of software engineering tools needed.

(Source: *Le Monde Informatique*, 7 April 1995)

A new text compression technique based on language structure

As the amount of information increases, there is a growing need for higher capacity storage devices and communication channels. One way of reducing costs is to reduce the redundancy of information by compression. An algorithm has been developed which takes the common morphological structure of the language and partitions words into their components (root and suffixes) of variable length and compresses these fragments using built-in dictionaries. The structural text compression algorithm and a worked example and theoretical considerations are presented. The algorithm has been tested on the Turkish language using C programming language, as this combines the powerful features of a high-level language and the device capabilities of an assembly language. This implementation is described in terms of the structure of the Turkish language and the algorithm is applied to three different text groups of different lengths.

It is concluded that this new compression technique, which takes the structure of language into consideration, can result in a compression of up to 47 per cent. It is reasonable to expect a compression percentage of at least a quarter in any application. The content and size of the dictionaries are the major factors affecting the compression ratio in the algorithm. Experience indicates that the second dictionary can be organized in a subject independent manner containing the most commonly used language roots. The proposed approach provides an easy to extend technique as languages of similar structures can be compressed by changing the entries in the built-in dictionaries. The appendix details the main steps in the algorithm used. (Source: *Journal of Information Science*, 21(2) 1995)

Catriona: netting the cat and PACing the Net

Cataloguing and Retrieval of Information over Networks Applications (CATRIONA) is a project to investigate the cataloguing of electronic information objects (EIOs) and retrieving the EIO from a wide area network, such as the Internet, for display and manipulation on a local public access catalogue computer (PAC). Phase 1 of CATRIONA, a feasibility study, has been completed with funding from the British Library Research and

Development Department. Phase 2 envisages the development of a demonstrator system, based on, but not exclusive to the university libraries of Scotland, and funding has been sought from the Follett Implementation Group for Information Technology (FIGIT). One of the case studies will be Napier University Library. Electronic resources at the Napier University Library currently comprise mainly CD-ROMs and a small number of DOS or Windows applications. Many are associated with printed information, either direct equivalents or auxiliary material such as manuals or how to textbooks. To actually look at any resources the inquirer has to log-off from the PAC and walk to the appropriate shelf or enter afresh the university network to use electronic resources. What is required is a system which can go from PAC to the resource, and then back to the PAC again, without necessary intervention. CATRIONA has shown that this facility can be implemented with the new generation of client/server library management systems. The new PACs can extract this data and use it to retrieve the resource, complete with the shell software required to view and manipulate it. (Source: *Catalogue and Index*, Spring 1995)

Client/server computing

Although the origins of the term "client/server computing" are obscure, it has now become firmly established in current terminology. It describes a process under which one computer (the "requester" or "client") conveys its requirements to another (the "server") using a common protocol. As such, it is one of a number of distributed computing paradigms, or methods of partitioning a computing task or program between resources provided by more than one computer system. Perhaps the commonest example is where a client accesses a database server using the Structured Query Language (SQL).

The motivation for the adoption of distributed computing, and hence client/server architectures, arises out of the need to replace monolithic, mainframe-based systems. The costs of doing so are such that a system based on networked desktop PCs appears an attractive alternative. Although the incremental costs associated with this are modest, however, desktop devices are expensive in the aggregate, especially in terms of support, and troubleshooting becomes more complex.

Libraries have been major beneficiaries of the introduction of client/server computing. Two of the more important areas have been in library automation, and the availability of information via the World Wide Web (WWW) as an alternative to expensive serials. Unfortunately, finding quality information in a usable form on the Web is both time-consuming and difficult. Cataloguers and indexers, however, are beginning to address the issues of information management on the Web. (Source: *Felicitas*, April 1995)

All wired up with no place to go

The Internet has generated a great deal of hype in the last year or two. It has been claimed that in the not too distant future it will provide the source for all our information requirements. But how relevant is the Internet to the work of the information professional, and what is it actually like to use in practice?

The Internet can be broken down into five sections: E-mail, Usenet, File Transfer Protocol (FTP), Telnet and the World Wide Web. It is worth getting access to the Internet just for the ability to send messages around the world to any one of the 30 million and growing members

of the Internet community. Usenet is like a giant bulletin board. There are several groups covering information and librarianship, with regular contributions, which range from straightforward questions to in-depth discussions on the nature of the profession. In addition, you are likely to find at least one Usenet group related to your organization's subject field.

File Transfer Protocol (FTP) is one of the fundamental standards of the Internet. It enables you to download files from any source on the Internet to your computer. However, most of the recent Internet browsers such as Mosaic or Netscape make downloading files very easy. Once you have found the file you want simply click on the name and the software will do the rest. Telneting is using the Internet to log on to any of the computer systems that are prepared to make their services available. It should be possible to access a wide range of academic library databases across the world, enabling you to search for references and holdings.

The World Wide Web (WWW) is a series of hundreds of thousands of hyper-text pages, similar in concept to those found on a standard Windows help menu. Any page on the Web can be linked to any other page regardless of where in the world it is located, hence the concept of cyberspace. There were three principal reasons to use the Web. Firstly, the software allows the combined use of graphics, colour and a choice of typefaces to produce a rival to the printed page. Secondly, the system is simplicity itself to use. Thirdly, thousands of organizations are busy putting their information into a WWW format, so making it freely available to anyone logged on. (Source: *Library Manager*, 6 April 1995)

Individual's big Web experiment (NewsPage)

Some prominent information providers have teamed up with Individual Inc. to see how much demand there is to deliver data via the World Wide Web. For the next four months the current awareness firm is giving away data from over 500 information sources, including Reuters, Associated Press, Ziff-Davis and 80 US newspapers, via a Web service called NewsPage. Also offered is PR Newswire, Business Wire, and magazines from trade publishers CMP and IDG. According to Individual, the majority of its data providers have signed up. One notable exception is the Financial Times.

Interestingly some of the costs of the service are being recouped through advertising. Companies can sponsor pages relevant to their product lines: for example, hand-held computers. Four companies, Digital, Sybase, Silicon Graphics and Eprl, have committed to sponsor pages. This gives space on four topics, plus feedback on the type and number of people accessing those pages; but not e-mail addresses or contact information. After the project ends, Individual may begin charging users for access, depending on how much advertising has been sold.

So how does it all work? Once at the NewsPage home page, users scroll through lists broken down into subject categories, which become more and more specific before reaching news stories on the topic. For example, you can start off at the High Performance Computing category, move on to Computer Hardware Peripherals, then drill through further to Midrange Computer Systems before finally reaching news. While moving through subject categories appears cumbersome the first time you use the service, you can bookmark those of interest or retrieve a hypertext index of the whole index. (Source: *Monitor*, April 1995)

Setting up a World Wide Web site

Using the World Wide Web to distribute information that your organization currently provides for free is one of the main benefits of setting up a web site. A company may distribute its annual report to shareholders, a publisher sends out a catalogue to inquirers or a library advertises a change in its opening hours to readers. These activities may all eventually bring increased investment, orders or usage, but represent a cost to the organization concerned. The WWW provides a way to disseminate information very widely and at very little cost.

It is possible to set up your own World Wide Web site using a computer on your premises. Access to the Internet is via a permanent telephone connection (leased line). This option is not cheap, expect to pay about £20,000 in set-up costs. To justify that kind of investment, some organizations then devote a full-time staff member to controlling the content of the site and sometimes another member of staff to provide technical advice. The advantage of this approach is the total control it offers over content: you can update information instantly.

It is usually far cheaper to rent space on a computer maintained for that purpose by an Internet access company, such as Demon, Pipex or Eunet. Charges are usually expressed as a set-up of a few hundred pounds and monthly storage charges of a few pounds per megabyte of data. There are three critically important questions to ask your site provider: how frequently and at what cost can the information be updated? What statistics on use can be provided? Will the site provider maintain an ordering system for you? (Source: *Managing Information*, April 1995)

Lab test: Network administration software

This review concentrates on network administration software, use 1 for tasks such as application metering, hard- and software inventory and remote diagnosis. Five packages were compared: Frye *Utilities for Networks* (£335 for a single server), Intel *LANdesk Management Suite 2.0* (£500 for five users), McAfee *Brightworks 1.2* (£495 for ten users), Saber *LAN Workstation 5.0* (£199 for the first node) and Symantec's *The Norton Administrator for Networks 1.5* (£350 for five users). All except Frye *Utilities* are packaged as a suite; the exception is a set of ten integrated modules, of which five were examined in detail.

Three emerged as worthy of recommendation: Intel *LANdesk* provided detailed information on system resources. Its extensive alert management system (AMS) could be programmed to respond to changes or thresholds. Remote control, however, was poorly implemented. *The Norton Administrator* only handled inventory, software distribution and metering, but was very easy to use. The Saber product was recommended despite its performing poorly in two of the usability tests. It was the only one providing disk and file auditing, and was bundled with *ReachOut*, an excellent remote control package.

Frye *Utilities* offered good traffic monitoring and hardware inventory facilities, but had a dated DOS interface and a poor manual. *BrightWorks* had good software inventory capabilities, but limited overall functionality. (Source: *PC User*, 17-30 May 1995)

The use of industry standard software

Surrey Record Office in England locates and acquires records relating to the history of the county, preserves them

and makes them available to researchers. The official archives have been collected since 1659, and the Record Office now holds a very large amount of original source material relating to the history of the county. Since the early 1980s, the desktop personal computer has provided archivists with the opportunity to use computers as a tool for information management. There are three levels of information to be managed—archives that vary in age, format and legibility; catalogues which describe the archives; and indexes to the catalogues. Problems in retrieving information from paper-based systems are location, format and information content. In 1987 the Surrey County Council Terminal Access Programme provided equipment linked to the County Council mainframe, which provided access to various mainframe facilities and could be used for stand alone for word processing. In 1989 staff were trained to use Word for Windows and an optical character recognition project was initiated.

This project is to run from 1992 to 1996 and uses Cache software which combines scanning and retrieval software, and provides text and image handling in one package. There are five main functions—input and character recognition; indexing; storage; retrieval; and output. A Fujitsu scanner and OCR software Calera Truescan running under DOS are used. It is a menu-driven system which allows the user to configure the scanner. Electronic files were indexed using the Corporate Retriever, which had been used previously by the Council to index committee minutes. It is concluded that the project had demonstrated that industry standard software can be used effectively. DBaseIII plus has proved a tried and tested database package, well suited to library requirements. Superbase was selected for the accessions and depositors database. The advent of multimedia computing, networks, and the information superhighway places the onus on archivists to develop methods of making information in their custody available electronically. (Source: *Program*, April 1995)

Getting the picture on image databases: the basics

Computers can now store not only cataloguing records about images and objects, but also surrogate images. Users that have access to such images are likely to require far less detailed descriptive information in the cataloguing records. With increases in storage capacity and bandwidth, multi-user image databases are finally becoming financially feasible. The choice of imaging technology will depend on who will use the resulting database and how it will be used. User studies are more useful when segmented by image type, user groups and use functions. Uses and users should then be related to the required level of image quality. Images in an image database will require accompanying documentation, and this will also vary depending upon institutional and user needs. If an institution wishes to exchange images with other institutions and ensure a clear upgrade path for its system, it is necessary to adhere to common standards. Most searches of image databases begin with text based queries, and different groups of users have different criteria for the images they seek.

Before selecting image database software, it is necessary to identify categories of information that must be searchable. In future, it may be possible to retrieve images based on criteria other than preassigned index terms. Current research into automatic indexing and pattern recognition may prove fruitful in retrieving images by colours,

icon shapes and the position of elements within the image frame. Planning should also include consideration of legal questions and image quality must be evaluated in terms of use. Most image databases consist of three basic components—a text database; software for browsing and detail viewing. The large consumer market-place has driven the development of image browsers who anticipate thousands of sales. The type of scanner used will be influenced by whether capture is to be from the work itself or from photographic reproductions. It is concluded that digital imaging holds promise for providing wider access to original material provided common standards are used in both technical and descriptive areas. (Source: *Database* April/May 1995)

Geographic information systems: an information management tool

Geographic information systems (GIS) are computerized information management systems that are designed to capture, edit, store, retrieve, process and disseminate spatial and attribute data which are referenced to some predefined geographic/geodetic referencing systems. GIS consists of subsystems which combine to perform GIS functions—hardware, software, data and database, and institutional. In addition to these physical components, GIS has functional components—data collection; data preparation; data integration; development of application; and database management. The benefits of GIS are providing integrated data storage and data retrieval capabilities; encouraging a more systematic approach for the collection of data; reduction of the overall cost of data collection and management; increased compatibility and comparability of diverse data sets; making data accessible to a wider range of decision makers; and facilitating spatial analysis of multi-criteria phenomena.

The major areas of GIS practical application are the development of street networks; natural resource applications; land parcel management; and facilities management. The nature and characteristics of environment management demand that databases and computing environments must have the capability for multi-criteria modelling, time series analysis, and data integration. (Source: *FID News Bulletin*, 4 March 1995)

The model Information Marketplace

The Information Marketplace model is an attempt to produce a model for electronic copyright clearance, information metering and electronic publishing on the Internet. This architecture and strategy is being developed by a cooperative effort involving Folio Corporation, Novell and the US Copyright Clearance Center (CCC), amongst others.

The requirements being addressed include the provision of secure, wide-area networking; robust, scaleable servers; ubiquitous connectivity; a critical mass of business-to-business information; and flexible publishing tools. Information needed to develop the model will come from more than 500 commercial electronic publishers, through Folio's parent company, Reed Elsevier, and its sister company, LEXIS-NEXIS, as well as from the publishers represented by the CCC. Tools will come from Folio's Open Infobase Architecture, and from Novell, Lotus, Powersoft and others.

"InfoApps", or customized applications, will enable publishers to sell electronic subscriptions and metered portions of their information base to customers via information providers. The latter will provide copyright

clearance, assure the anonymity of the consumer, authorize users by means of credit authorizing services, bill for information usage and make payments to the publishers.

Folio and the CCC have agreed to develop technical and contractual systems to support electronic access to books, journals, newsletters and newspapers. Initially, the service will support metered, per-use access to digitized material on CD-ROM and on LANs, but from 1996 onwards, it will be extended to WANs such as the Internet. (Source: *Information Retrieval & Library Automation*, March 1995)

New Internet software

This article briefing outlines four new Internet products: Web-in-a-Box, InterNotes, WordPerfect Internet Publisher, and Verity's World Wide Web server. Web-in-a-Box, a joint offering from a consortium including Digital, Uniplan, Hamilton Rentals and EMWAC, is aimed at organizations wanting to put their own information on to the World Wide Web. This all-inclusive service from prices upwards of \$5,000 includes a DEC server machine with Windows NT and software from EMWAC. InterNotes is the cover name for a series of Lotus products aimed at integrating information from Lotus Notes with that on the Web.

The InterNotes Web publisher allows Notes information to be out into HTML form for access by Web browsers. WordPerfect Internet Publisher allows users to create and view Internet documents from within WordPerfect with an automatic translation, so that users will not need to know anything about the Web's HTML language. Verity, known for their text retrieval expertise and particularly for their widely used Topic software, are providing a World Wide Web server with an integrated text searching engine. (Source: *IT Link*, April 1995)

Software distribution via the Internet

Software suppliers such as Oracle, Informix and Borland are now distributing their products over the Internet. This year, US-based CyberSource started distributing packages in the same way. The company states it can offer over 8,000 products, from companies including Symantec, FTP Software, OnTechnology, Now Software, Farallon and InterCon Software. Would-be purchasers supply a credit card number, and the software is downloaded to the customer's computer for a 30-day trial.

Software distribution in this manner offers a number of advantages. Middlemen are eliminated, so costs are reduced. Registration is mandatory and immediate. There are also problems, however. One of the more obvious ones is that of security: many hesitate to supply credit card details over the Internet, given its poor security. Another is the limited bandwidth provided by the existing telecommunications infrastructure. Many companies still have only 9,600 baud modems at their disposal, so downloading something as simple as CompuServe Information Manager would take 56 minutes. Given this, downloading an operating system or relational database appears impractical. An alternative approach is to distribute coded software on CDs, with users obtaining the necessary keys over the Internet. A CD-ROM costs as little as 40p, the cost of a local telephone call. Infobank, a UK software distributor, offers disks containing software from Microsoft, Lotus and Novell.

In the meantime, some companies are using the Internet as a backup and support tool, once the software is

installed. IBM, Microsoft and Novell all have FTP sites: users can dial in and obtain drivers and other items required to run their systems. (Source: *Connexion*, 3 April 1995)

The word processor is ticking

"Metering" software—programs that let PC users pay for their word processors and spreadsheets according to use—is emerging as the new way for big companies to cut their skyrocketing software costs.

Software meters let companies find out exactly how many programs they need, and then put them in the hands of those who need them most.

The Gartner Group, a consultancy in Stamford, Connecticut, estimates that 10-15 per cent of corporate PCs are now hooked up to software meters. It predicts that the

market, currently worth \$120-150 million, will grow as much as 40 per cent this year as new metering technology lets companies share licences between offices. It could grow even more when metering moves beyond software to pay-per-view information in general.

Wave Systems, a company based in New York, is already testing such a system in several law firms. It uses a hacker-proof chip that can be loaded, like a telephone smart card, with electronic money. When lawyers request a particular article from a database, the chip subtracts the cost of the information from its electronic purse. As with software metering, users pay only for what they use. Compared with the cost of buying a legal database outright, paying as you go with a trickle of electronic cash may seem like pennies from heaven. (Source: *The Economist*, 8 April 1995)

G. COUNTRY NEWS

China

Fibre-optic cable links cross China

China has recently begun construction on two major fibre-optic cable lines crossing the country from east to west, which are expected to go into operation before the year's end.

Sources at the Ministry of Posts and Telecommunications said that a modern optic-cable telecommunications network, composed of 22 trunk optic-cable lines with a total length of 37,000 km, will be ready by the end of the year.

The first of the two lines runs from Hangzhou and Fuzhou on the east coast through Guiyang, Zunyi and Chongqing to Chengdu in Sichuan province. The total length is 4,352 km. It will provide 120,000 long-distance communications lines.

The other runs from Beijing through Hohhot and Yinchuan to Lanzhou in Gansu Province, with a total length of 2,133 km, providing 30,000 long-distance communications lines.

The two long-distance telecommunications lines are funded by the World Bank and aim to improve telecommunications in the economically underdeveloped areas in south-west and north-west China.

During the Ninth 5-Year Plan period (1996-2000), China is expected to build 17 trunk lines and 11 ground satellite stations. By then, every provincial capital will be connected with more than one trunk fibre-optic cable line and will have at least one ground satellite station.

By the end of this century, China expects to have over 60,000 km of trunk lines to connect all the provincial cities as well as some large and medium-sized cities.

In 1994, China invested 68.3 billion yuan (\$8.13 billion) in telecommunications infrastructure, while this year's total input is expected to exceed 80 billion yuan (\$9.5 billion). (Source: *China Daily*, 20 March 1995)

IBM, Shanghai Jiaotong University jointly build Asia's first full-function computer network

IBM and Shanghai Jiaotong University have announced that they have reached an agreement on the joint construction of Asia's first full-function computer network: a network centre and ATM [asynchronous transfer mode] local area network (LAN), to be built at Shanghai Jiaotong University. This high-speed LAN, which will permit integrated data/voice/image transmission, will then be joined via a high-speed network to computers at all institutions of higher education in Shanghai Municipality and Zhejiang, Jiangxi, and Fujian provinces. By the end of the century, the network will be expanded to middle and elementary schools in these areas as well as to other educational and research institutes and to commercial and industrial firms. This computer network can be connected to the Internet, making Shanghai Jiaotong one of the 10 large network points for the China Educational and Research Computer Network (CERNET). (Source: *Wen Hui Bao*, 25 February 1995)

A web for the masses

While Internet access in China is still limited, the Government is moving to expand the network. The

Ministry of Post and Telecommunications is to begin offering commercial Internet access using two capacious long-distance lines recently installed by Sprint, the US telecommunications firm. The new service will allow broader access in China, where only an official elite is now on-line. Fees have yet to be announced, but they are expected to be substantially lower than what the MPT charges its large institutional customers. Eventually, officials say, anyone in the country with a computer, a modem, and a telephone will be able to call up information from tens of thousands of global databases as well as exchange messages with an estimated 36 million Internet users around the world.

If Chinese officials seem untroubled about granting Internet access to the masses, that may be because only a small, privileged group can take up the offer right now. China has only one telephone for every 200 people (versus 42 phones for every 100 people in Japan). Despite government plans to spend up to \$43 billion building a modern telecommunications system over the next six years, demand still outstrips supply. In the Beijing area, 90,000 people have paid for a phone but not yet received one. The installation fee is around \$595. A modem-equipped computer can total around \$2,000. By comparison, the average annual income in China's urban areas is about \$375. (Source: *Time*, 10 April 1995)

New development modes

China's electronics industry is in the process of shifting from a traditional unitary manufacturing industry to a modern electronic information processing industry featuring the simultaneous development of manufacturing, software and information services. The new development mode has certain distinct features and contents, meaning that material production will be combined with intellectual production, equipment production with networking, hardware manufacturing with software production, and industrial production with operating services.

Under the previous planned economic system, the electronics industry was limited to the manufacture of hardware and related elements and, as a result, China lagged far behind in the development of system integration and software. While information processing services and networking operations were within sight, they were none the less beyond reach.

The new development mode will be a mutually beneficial interdependent structural system featuring enhanced adaptability and competitiveness. As such, it will form an efficient circulation pattern in which system integration and the development of equipment promote each other. The general programme for the short-term development of the electronics industry is:

- Accelerating the development of the information processing industry, represented by the "Golden Bridge", "Golden Customs", and "Golden Card" projects.
- In line with the market demand for information processing projects, extending great effort to ensure technicians solve technically complicated electronics problems, develop and manufacture related auxiliary products, while at the same time increasing self-sufficiency and the market share

of domestically manufactured electronic equipment. Preliminary estimates show that investments in the construction of systems and networks during the Ninth 5-Year Plan period (1996-2000) will reach 500 billion yuan. Key equipment will include program-controlled switchboards with 10 million lines, 500,000 core km of optical fibre cable, 1.5 million sets of mobile telecommunications equipment, 1 million fax machines, over 1,000 complete sets of small and medium-sized satellite telecommunications ground stations, 5,000 small computers and operating platforms, 0.8-1 million minicomputers, 20-30 million card cores, 2,000-2,500 automated transfer machines, 30,000-50,000 POS machines and 250,000-300,000 terminals of various types.

Vigorously promoting the application of electronic information processing technology and related products in order to supply modern electronic equipment required to transform traditional sectors and enhance the intensive operational level of the national economy. The industry will focus on the research development of electronic equipment for the energy, aviation, communications, agriculture, metallurgy, medical, cultural and educational sectors, as well as electronics equipment for the Three Gorges Project.

Actively undertaking high-level development of high-quality electronic consumer products with a greater economy of scale, raising price ratios in line with product quality and functions, and contributions to the country's flourishing markets, guaranteeing supply and curbing inflation. While producing high-quality traditional consumer electronic products, the electronics industry will accelerate research and production of HDTV, LDs, digital audio equipment, video cameras, erasable and recordable mini digital CDs, cable TV equipment, and digital audio broadcasting transmission equipment.

Strengthening projects related to mini-electronic and basic products. Great effort will be extended to create conditions for research and development of various types of equipment. Over the next few years of efforts, we will establish a base for the production of 0.8-1 micron integrated circuits, master technology for 0.3-0.4 micron integrated circuits, and acquire the capability to mass produce 0.5-0.6 micron products. Development of colour TV tubes will centre on large screen high-definition tubes. In addition, a specialized sector will form around the production of liquid crystal display devices. Integrated electronic elements will gradually diminish in size, becoming thin and flat, with minimal components.

(Extracted from *Beijing Review*, 20-26 February 1995)

Tianjin University develops controllable piezoelectric motor

The "large-displacement ultra-vernier continuously controllable piezoelectric motor" developed by the Tianjin University Department of Precision Instruments under a Tianjin Municipal Natural Sciences Foundation grant was recently certified by the Tianjin Municipal Science and Technology Commission.

This piezoelectric motor has a nanoscale vernier and a 50 mm movement range, a drive force of 6 N [newtons], and a drive speed of 0.1 mm/s. Applications include precision instruments, ultraprecision manufacturing, electronics, aerospace, astronomy, laser technology, and nanotechnology. (Source: *Chinese Science News*, 13 February 1995)

1-Micron integrated circuit developed by Huajing Group

On 27 January 1995, the China Huajing Electronics Group's Central Research Institute completed its development of a 1-micron-standard integrated circuit (IC): the FCT245 eight-channel receiver/transmitter. This high-speed CMOS IC, using 1-micron design rules, is made with a double-layer-metal single-layer polysilicon process, has an LDD [lightly doped drain] structure, a design channel length of 1 micron, a gate oxide layer thickness of 20 nm, and contact hole dimensions of 1 micron x 1 micron. The fabrication process includes over 200 steps, among which 16 involve photolithography. Yield from the first wafer was 70 per cent. The FCT245 is a general-purpose logic circuit in wide use today for data bus duplex communications, a critical part of the Information Highway. The Huajing researchers are also nearing completion of development of a 1-1.5 micron 256K SRAM, a 1-megabit mask ROM, and a high-speed digital signal processor, and are in the process of converting a large MOS production line. (Source: *China Electronics News*, 14 February 1995)

France

France Telecom to invest in information super-highway experimentation

France Telecom intends to invest FF 1 billion over the next three or four years as part of its experimentation with information superhighways. The programme includes nine projects approved by the Government. Investments will be concerned with networks, services, and intermediate functions (of the same type as the Minitel information service) between information providers and users.

The Dora project alone will need about FF 500 million. Its purpose is the deployment, beginning at the end of 1996, of a high-throughput fibre-optic network with from 50,000 to 100,000 connections. A second project, known as Batru Superhighways, is aimed at experimenting with the end-to-end ATM technique, extending it even to residential subscribers. Beginning in mid-1996, testing will take place along a route stretching from Paris to Brest and involving a cable network and several optical distribution networks. Also to be tested beginning at the end of the year is video transmission by copper pair using ADSL [Asymmetric Bit Rate Digital Subscriber Line] technology. Lastly, a Numeris platform will be employed over an area that is 100 per cent equipped for from 2,000 to 3,000 residential and professional users.

For the intermediate platform, two approaches are being proposed: microcomputer information service and Jasmin. The latter will offer wideband reference services in mid-1996 and will rely on the various distribution media for residential customers (fibre optics, copper, coaxial, radio waves, and satellites).

The services provided on those networks and accessible via the platforms will range from packaged services for the mass consumer market (in partnership with Bellanger-Filipacchi and Lyons Communications) and audiovisual services (television shopping and the downloading of games)

to professional services (especially in the field of exports and training) and remote services (adding engineering schools, long-distance teaching, and health services to networks). (Source: *Le Monde Informatique*, 17 March 1995)

Israel

Jerusalem University builds parallel computer

Israel has built a computer with a multiprocessor that enables 28 processing units to work simultaneously. According to the researchers from Jerusalem University who built it, the new computer will be able to meet all Israeli requirements for the research and technological development sectors.

One of the characteristics of the parallel computer is its ability to make maximum use of all the components. The current indication of the price is \$150,000, this being lower than the cost of a system with the same characteristics that is already on the market.

The new computer, that can work with the UNIX operating system or a compatible one, has been used for research and development of algorithms and parallel systems, for advanced courses in parallel computing, and for scientific applications that require large computing capabilities.

The core of the computer is made up of a central processing unit that uses a system of Pentium microprocessors. The peripheral nodes are limited to 28 for the time being; however the researchers from Jerusalem University are working to increase the number of workstations to 32. (Source: *Ansaservice Database*, 22 March 1995)

Italy

Researchers announce revolutionary hard-disk access system

A hard disk access system which is claimed can cut hard disk access times by a factor of 10,000 was announced by two electronics engineers in an appeal for major funding to bring the device into production.

The inventors, Emanuele Bonotto and Giuliano Macripo, said that their patented access system cuts the 100th of a second currently taken by a good hard disk to reach a given item of information to a "reaction velocity of a 1,000,000th of a second".

"This means a full-fledged revolution, since it brings the speed of the hard disk close to that of the central memory", said the two engineers, partners in a small company, Daker, which operates out of Udine in northern Italy, employing 35 to produce back-up generators for major industrial groups.

The main bottleneck in computers remains the speed at which data can be retrieved from mass memory systems, of which the most commonly used form is the hard disk.

Macripo, the electronics engineer who designed the Daker Patent system, sees it as crucial in developing virtual reality applications needing the massive use of memory.

The two inventors reported that sophisticated equipment was needed to produce their device, and this would mean large investments. They reported that their discovery had emerged "almost by chance, as tends to happen when you have a passion for problems of this kind". (Source: *Ansaservice Database*, 31 March 1995)

Singapore

Information technology enables business process re-engineering at YCH DistriPark

The Yap Chwee Hock Distribution Park in Tuas, Singapore started as a passenger transport company in the 1950s, changed its business to cargo transportation in the 1970s, and is today offering "total logistics". Information technology (IT) has played a significant role in the business process re-engineering at YCH in transforming the company to its current status as a regional leader in offering total logistics.

Logistics at YCH starts with operating a group of central distribution centres or warehouses with storage systems tailored for each client's products, handling chemicals for DuPont, electronics for AIWA, medical products for Roche and so on. It then adds a package of services like container haulage, international sea/air freight forwarding, inventory control, etc.

Three major IT applications devised by YCH, namely the Warehouse Management System, Freight Management System, and Logistics Managements System are integrated with the country's electronic data interchange networks TRADENET and PORTNET in providing total logistics. In 1992, YCH won the National Computer Award in the Local Enterprise category, in recognition of achieving superior business performance through strategic applications of IT. (Source: *Journal of Strategic Information Systems*, March 1995)

United Kingdom

IT purchasing problems

Purchases of IT equipment amount to over £10,000 million a year in the UK alone. Computer buyers, however, encounter many problems, ranging from rapid obsolescence and equipment not performing as specified, to ill-defined contracts and suppliers going out of business. Some systems have proved to be expensive failures: examples include those at the Stock Exchange and the London Ambulance Service.

There is widespread anxiety regarding investment in computers. A survey of 50 company directors found that three quarters regarded IT purchasing as a serious problem. A similar study by Ernst & Young of 121 large-scale UK organizations found that the majority of respondents were unable to cite any benefits gained from such investment.

The problems are unlikely to become less acute over the next few years. The convergence of computing and telecommunications technologies means that even more variables must be taken into account when evaluating systems. The lack of industry standards means that some customers simply opt for the supplier with the largest market share, yet this can mean becoming overly dependent on a single source.

Unlike the building industry, the IT market is not characterized by standard contracts and conditions of business, yet agreements clearly defined in advance are the key to avoiding disappointment. These should specify what is expected in terms of throughput, performance, reliability and maintenance. The UK Department of Trade and Industry (DTI), in an attempt to improve the situation, has recently launched a two-year, £1 million campaign intended to promote best practice in IT procurement. (Source: *Management Today*, May 1995)

H. AUTOMATION

Crane crash avoidance sensor (micro-robot)

Wire Automatic Device Co., Ltd. has developed a crane crash avoidance sensor that prevents the collision of adjacent overhead cranes using circular microwave technology. This is the first time that an approach alarm sensor has been developed using such technology.

Opposing sensors are mounted on adjacent overhead cranes running on the same rails. When one crane approaches the detection area of an adjacent crane, its sensor detects the microwaves transmitted by that crane's sensor and generates an alarm, thus preventing collision.

The direction of rotation of the circular wave is reversed when reflection occurs. The sensor is set to discriminate out these reflected waves, thus eliminating spurious output due to reflection from walls, ceilings, etc. The sensor is not adversely affected by foreign matter accumulating on the detection surface or by surrounding vapours and airborne particles. As it uses amplitude modulation, multiple units can be installed near each other without interference.

The sensors may even be mounted on generator-driven cranes, which up to now has been impossible with the power supply synchronized type. An internal failure detection function is incorporated in the unit to constantly monitor signal transmission and reception. An indicator will light in the event of any failure. Maximum sensing range is 80 metres.

Further details from Wire Automatic Device Co., Ltd., 1-9-27, Jokoji, Amagasaki City, Hyogo Pref. 660. Tel.: +81-6-482-3838; Fax: +81-6-481-6321. (Source: *JETRO*, May 1995)

Automated preprinting plate CAD system for textile printing

Ricoh Co., Ltd. has developed a CAD system that automates the preprinting plate-making process using a special type of thermosensitive film newly developed by Ricoh and an A0 size precision, high speed thermal plotter for textile printing applications.

The fabric pattern is drawn by hand or computer and then loaded into the work workstation directory or through a scanner. After image processing and manipulation capture on the workstation, image data is transmitted to the A0 size thermal plotter for direct thermal printing onto the thermosensitive film for preparing the preprinting plate film used for textile printing. The processes for the design tracing of textile printing are accomplished in only three to five hours, compared with current manual operation which requires about one month normally.

The new system automates the processes of design tracing and screen preparation, and shortens the process time to within one day, with good system function for simple operation, high speed film output, and does not require an experienced operator. The new system is also applicable to designing pottery and high precision CAD system.

The system was marketed in September 1995 at a domestic price of ¥27 million.

Further details from: Ricoh Co., Ltd., Public Relations Dept., 1-15-5, Minamiaoyama, Minato-Ku, Tokyo 107. Tel.: +81-3-5411-4511; Fax: +81-3-3403-1578. (Source: *JETRO*, June 1995)

I. STANDARDIZATION AND LEGISLATION

Standardization

Competing high density CD standards

Today, a standard CD-ROM holds about 650 Mb of data, but the tendency to add space-consuming images, audio and video clips to information products creates a need for more capacity. A specific application requirement driving the development of high-density CD (HDCD) is its possible use as an alternative to VHS video tape. Video-CD has achieved a reasonable uptake in Europe, but films currently require more than one disc.

Unfortunately, there are two HDCD "standards" competing for recognition. Sony and Philips (backed by IBM and Microsoft) have developed the "Golden Book" standard, which specifies physical, data, file and applications standards. This would result in a largely universally playable disc, with the differences between products being those of information content rather than of file and data structure. A different format, however, has been specified by another consortium which comprises Hitachi, Pioneer, Toshiba, Denon, Mitsubishi and Matsushita, backed by Time/Warner. The Sony/Philips HDCD is a single-sided disc with multiple layers, each with a capacity of 3.7 Gb, whereas the Toshiba/Matsushita disc is double-sided, with a capacity of 5 Gb per side.

The Sony/Philips disc could be manufactured in existing plants with little or no modification, whereas the double-sided product introduces the sort of complexities which have kept the price of the existing double-sided LaserDisc so high. On the other hand, the additional data capacity of the Toshiba/Matsushita disc would be beneficial. It is likely that some compromise between the two will eventually be negotiated. (Source: *Personal Computer World*, May 1995)

NIST standard for excimer laser energy

The US National Institute of Standards and Technology (NIST, Boulder, Colorado) has a laser calorimeter primary standard for absolute energy measurements at the wavelength of 248 nm. Under sponsorship of SEMATECH, NIST engineers developed the calorimeter to improve measurement of dose energy used in excimer laser-based deep-UV lithography.

Briefly, the device uses a glass filter as a volume absorber, allowing the collection of nanosecond pulses of laser radiation without suffering damage. Energy absorption raises the filter's temperature, sensed with a thermopile. The resulting voltage curve correlates to total energy. (Reprinted with permission from *Semiconductor International Magazine*, Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA)

Legislation

The digital world and intellectual property

The widespread availability of digital information, whether delivered through any particular medium or simply through airwaves or cable, brings with it an increasing demand for copying and re-using information. However, protection should not aim to restrict access to the information but rather to open it up by defining simple,

easy-to-use controls which, moreover, will generate new business opportunities in the exploitation of copyrights.

The application field of existing copyright laws and regulations urgently needs to be extended in order to cope with the digital information environment and harmonize the various legal contexts related to intellectual property. Specific issues such as privacy of data, moral rights, integrity of information conveyed, responsibility for false or misleading information, have still to be covered. The scope for action is broad and complex. Encouraged by the potential economic importance of the new multimedia applications, technical solutions are beginning to emerge which aim to protect the rights attached to digital information transmitted over any kind of distributed networks, on- or off-line. Such systems are planned to include automatic licensing systems as well as the means to identify protected information and their usage rights and conditions.

The new possibilities offered by the wide and easy distribution of digital information will also affect the way society is currently organized. Political, economic as well as ethical choices will have to be made. Easy production of the information, widespread means of distribution and free access to the information will generate new economic activities, while others will disappear or will need thorough reorganization and restructuring. (Source: *I&T Magazine*, Winter 1994-95)

What price patent information? (EPO/INPI Questel dispute)

Last December a dispute involving the European Patent Office (EPO), the French National Patent Office (INPI) and Questel led to a three-week suspension of updates to the EPAT file. Although the updates were quickly restored the issues raised by the dispute have yet to be resolved. The seeds of last December's dispute go back to 1983, when the Administrative Council of the EPO decided it would allow third parties to distribute the EPO's internal database of patent information. Initially, this was restricted to European hosts nominated by their national patent office. In practice it meant that Questel acquired a privileged position as the only distributor of the EPAT file: a database produced by INPI from data supplied by the EPO and for which it pays only a marginal cost.

In 1988, however, the Administrative Council relaxed the rules on who could distribute EPO data and decided that it should be sold at market prices. In line with this decision, and following the EPO's acquisition of INPADOC in 1991, the EPO revised its charging structure and signed distribution agreements with both Dialog and STN. Under these contracts it was agreed that the hosts would pay a royalty fee of 40 per cent to the EPO. The EPO then began to exert pressure on Questel to agree to similar terms. Not surprisingly, Questel resisted.

After two years of unsuccessful negotiations with Questel-Orbit, the EPO took the unusual step of unilaterally suspending updates to INPI, pulling the plug in early December. In response to user complaints a meeting of the EPO Administrative Council was hastily called. The Heads of Delegation decided that the EPO should resume delivery immediately, with a retroactive solution to be agreed in the spring. When the issue will be resolved is another matter.

A resolution could be delayed until the President of the EPO takes office at the end of the year. (Source: *Monitor*, April 1995)

**Internet encryption ban "violates free speech"
(US court action)**

The US International Traffic in Arms Regulations (ITAR) controls the export of encryption techniques, classifying them as munitions. Now the US Government's interpretation of the law has been challenged in court as a violation of the "free speech" provisions enshrined in the Constitution.

Daniel Bernstein, a graduate student at the University of California, asked the State Department in 1992 for permission to publish his research on encryption. He intended to circulate an algorithm called *Snuffle*, together with a program based on it and a research paper, on the Internet. Since, however, postings on the Internet can be accessed from anywhere in the world, this constitutes "exporting" them. The Department required him to obtain separate approval for each recipient of the software or the paper, effectively prohibiting publication. An appeal in 1993 received no response, hence the current action. (Source: *New Scientist*, 15 April 1995)

J. RECENT PUBLICATIONS

Patent information on disk

Engineers and others who need to follow emerging technological developments world-wide may benefit from one or more of the 32 electronic newsletters published monthly by MicroPatent. The company puts out more than 10 newsletters of direct interest to electrical and electronics engineers—five on electronics, three on computers, and one each on energy, lasers, fibre optics, and telecommunications. Still others cover such fields as automobiles, textiles, pharmaceuticals, food technology, and medical devices.

Called World Patent Alerts (WPAs), the newsletters cover patents from all over the world, presenting information in a fully searchable form. The products are distributed on 90-mm floppy disks, which the company claims are dramatically easier to use than the US Patent and Trademark Office's *Official Gazette*, a weekly document the size of a telephone book.

WPA comes with Searchfast software with which users may search for patents using any combination of criteria, including issue date, patent number, classification, owner, inventor, and title or abstract text. By adding each new issue to previous issues, users can build complete back files for their industries.

The annual subscription rate for a WPA is \$295 for the first newsletter and \$150 for each additional one. Contact: MicroPatent, 250 Dodge Ave., East Haven, CT 06512-3358. Tel.: 203-466-5055, toll-free, 800-648-6787. Fax: 203-466-5054.

Chemical Abstracts on CD-ROM in 1996

Chemical Abstracts, known since early in the century as the "key to the world's chemical literature", will be on CD-ROM in 1996.

CA on CD will provide the same information available in the printed form. Content is derived from analysis of some 600,000 documents per year.

Like the printed version, the CD-ROM product will contain bibliographic citations with associated abstracts, chemical structure diagrams, keyword and volume indexing.

Chemical Abstract Services (CAS) says the CD will be compatible with both Windows and Macintosh systems and will allow text searching by a number of access points, including author name, keyword, substance names and chemical formulas.

