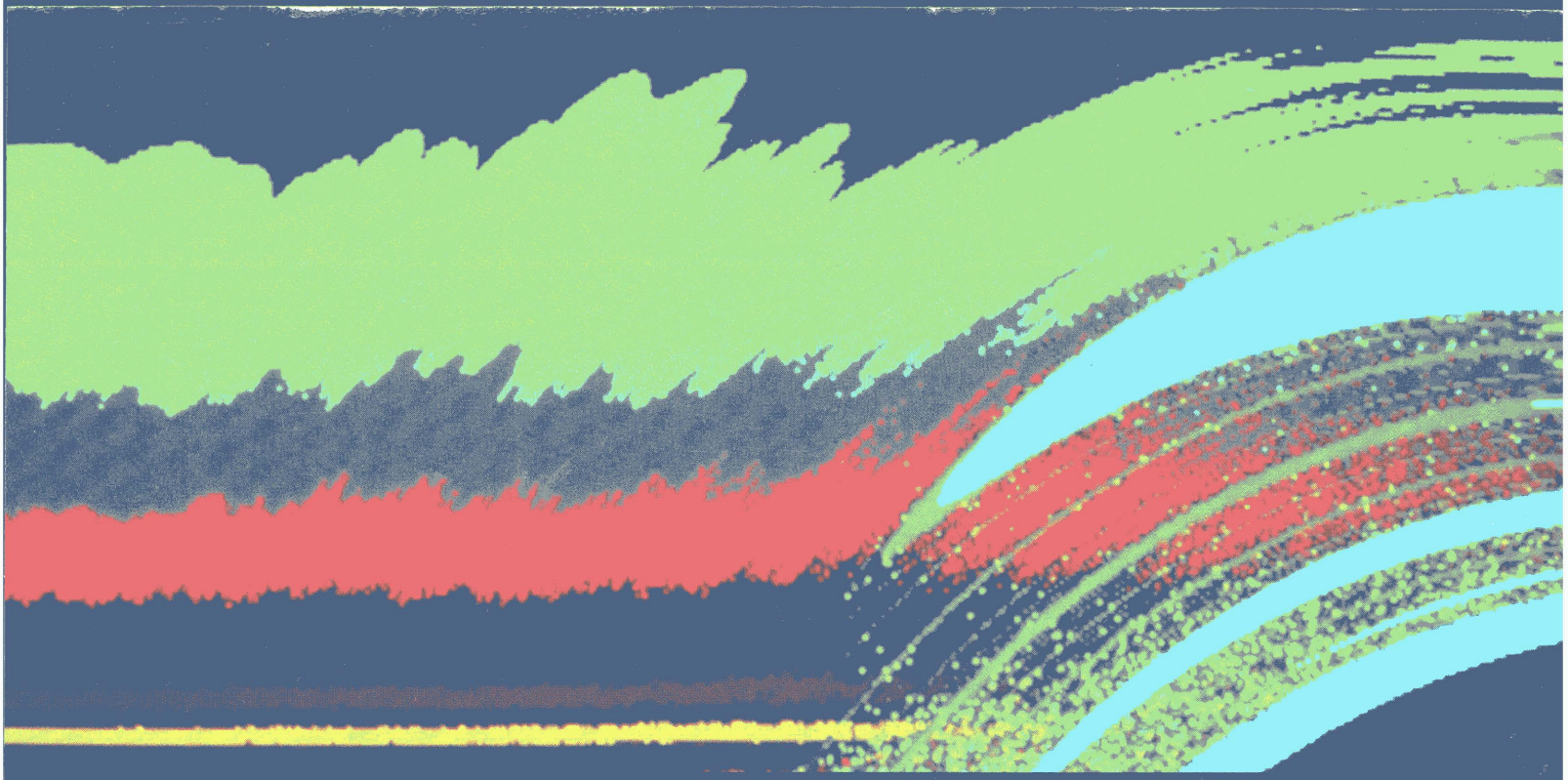

European Information Technology Observatory 93

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Preface

This is the first edition of the "European Information Technology Observatory". The EITO is a joint initiative by the EC-Commission, EUROBIT, and the European trade fairs CeBIT Hanover, SIMO Madrid and SMAU Milan. It has been produced with the support of the Directorate-General for Information Technologies and Industries and Telecommunications of the Commission of the European Communities.

The project for a comprehensive overview of the European market for the information technology industry coincides with fundamental steps in the integration of Europe. The idea originated from the President of SMAU, Enore Deotto, and it has taken an exceptional effort by the sponsoring organisations from both a financial and a qualitative point of view to produce this unique new compendium.

The European Information Technology Observatory presents the most comprehensive data available about the European information technology (IT) market. This first edition of the EITO describes and forecasts technological trends in the IT industry and presents detailed statistics about the full spectrum of market developments. It contains special studies about the European software market, the market potentials in Eastern Europe and the scenario for IT standardisation, and it analyses the environmental policies and requirements for the European IT industry.

The EITO has been produced in close cooperation with International Data Corporation. IDC has provided all of the statistics as well as major parts of the market analysis.

The European Information Technology Observatory is a unique and indispensable source of information in marketing and technology for European market players, users of information technology hardware, software and services, for trade fair organisations and trade fair visitors, for politicians, members of the European Commission and national government representatives, for organisations involved in R&D, standards and education relating to IT, and last but not least, for the media.

Up-to-date and valid information plays an increasingly important role in business and political decision-making. With its comprehensive resources of information in-depth, the EITO aims to make its contribution to the further economic and political integration of Europe. The initiative will be continued in coming years with annual editions of the EITO.

The EITO Sponsor Group

Imprint

European Information Technology Observatory 1993

Publisher:
European Information Technology Observatory (EITO)

EITO Sponsor Group:
EC Commission, DG XIII, Brussels
EUROBIT, Frankfurt/M.
CeBIT, Hanover
SIMO, Madrid
SMAU, Milan

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Copies can also be ordered from the sponsoring trade fairs.

Design:
HWL & Partner Design GmbH, Frankfurt/M.

Complete production:
Eggebrecht-Presse, Mainz

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Information Technology in Europe: EC Commission's View

Michel Carpentier, Director General of DG XIII*

Like the steam engine of the industrial revolution, and like labour of all times past, information technology (IT) pervades wealth creation at all stages of production – from design to manufacture and from conception to use. The value of most products or processes becomes increasingly dependent on their information content or their information processing capacity, whether this is information needed to apply the breaks of a car safely, whether it is rapidly processed information on the stock exchange or whether it is a humble control of a washing machine. Information technology is thus the engine that allows intelligent use of information to optimise the use of material, environment, energy and human resources in all kinds of activities, social as well as economic. IT is the generic technology "par excellence".

As well as being the object of an important industry in its own right, the generic nature of IT causes it to have an impact on all economic and social activities – from leisure to the stock market, from defense to manufacturing. The future holds an increasing such dependence and the most successful industries will be those that best exploit it.

At the same time, the nature of the dependence of industry on IT changes along with the balance of the IT-related market forces. This mutation is closely observed by the Commission of the European Communities whose policy is to adapt to the changing scene in a dynamic and continuous manner.

Our perception of the industrial importance of IT has changed drastically over the last ten years. We started by looking at IT as either giving end products directly to the user, whether these products were computers, or software, or supplying with electronic components the IT industry itself. This was a "closed-world" view of IT in which the profitability and effectiveness of the IT industry was seen as more important to the economy as a whole than the use that was made of it. IT was relatively scarce and the users, who had limited know-how and, through relatively limited supplier choice, a limited influence on the nature of IT, had solutions largely imposed on them by the suppliers.

Information Technology: A Period of Mutation?

Our changing view is due on the one hand on the pervasiveness of IT and, on the other, of an unprecedented acceleration of technological development which has meant that small temporal advantages have been amplified into disproportionate advantages of market share not only for IT but also for other products with a significant IT content.

The relationship between suppliers and users has changed towards one of added indirect benefit in two ways: firstly, the benefit to the economy of the efficient use of IT has overtaken that of the profits from the supply. Secondly, the incorporation of IT into the activities of other industries has resulted in IT playing a greater leveraging role than ever before, as well as a key role for competitivity.

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Users have become increasingly IT-literate. In the process of becoming so, they realised the importance of open systems and the need not to be hostages of a single supplier for activities on which their enterprises increasingly depended. The response of technology to these demands has, in our days, come to an interesting paradox, entering an accelerating loop of technological advance - demand - supply, while at the same time becoming less profitable in its own right.

Partly induced by recession and partly induced by technological advance and the opening up of systems, global profits of the IT industry have fallen, together with prices, while the "IT power" being supplied has gone up. Although the IT industry is poorer in cash, the world is richer in IT. In terms of incorporation of IT in products and services, we have real growth, indeed acceleration, of the use of IT, and thus of IT influence on overall industrial performance.

The ability of IT to embed itself into just about everything is the second source of the current mutations, one whose significance we can see explode. Ability to embed gives leverage. Consider cameras. The IT element in modern cameras consists not only of the very advanced CAD that has gone into their design, but also of the very advanced electronics and intelligence that is embedded into each individual camera. The concentration of camera production away from the countries in which photography originated and is most widely used to those where miniaturisation and IT embedding is most advanced provides a typical example of IT leverage.

In a world climate of diminishing growth, indeed of recession in places, and of increased competition companies vie for small advantages. Even a small edge in a product can sweep the market. The leverage effect of IT on industries, such as cars, aerospace, television and mobile communications, to name but a few, is here to stay.

The convergence between IT and communications is expected to have an even more profound impact on the economy and, especially, society with the ability to combine complete communication and personal information processing systems on single portable units. The advent of the mobile "personal communicator" as well as of the closest integration between communication and information processing is likely to influence more than anything our patterns of work and leisure and have, in the process, also a profound impact on the consumer market.

IT is becoming the main focus of attention in a very different market from its original one. This is the market of consumer electronics, from entertainment to household goods. The volume characteristics of the consumer electronics market enable a substantial justification for the development of IT and thus bear, indirectly, much of the cost of its other uses.

Economical changes affect technological change. As competition becomes fiercer the importance of coming first with the right solutions becomes paramount. Coming first with the right LCD technology does not simply mean not to have to import a costly component of, for example, television sets - it means the ability to have a television industry at all.

This interdependence favours mostly those that have the ability to take a global view beyond the interests of narrow industrial sectors. Japanese companies have been able to achieve this through a massive vertical integration of individual companies as well as of industrial conglomerates, coupled with a strong industrial strategy. In Europe Japanese-style vertical integration and large industrial conglomerates have not proved compatible with our diversity and free competition. Instead, an important instrument able to achieve the process of selection and focalisation of effort where there is most leverage is an industrial policy, the key to the efficient reinforcement of competitiveness.

Information Technology in Europe: Our Relative Position

The current competitive position of Japan did not happen by chance, is not simply the result of hard work and is certainly not due to a local wealth of natural resources. A country poor in raw materials, with a limited internal market and workforce and with its trading partners far from its shores has achieved its position through a coherent and explicit industrial policy. It has taken 20 years of commitment to reach its current position. In the heart of this industrial policy, there has been the will to lower resource consumption and increase the high added-value business, especially in and through information technology.

The industrial policy in Japan consists mainly of a package of tax incentives and publicly supported cooperative research and development (R & D) but, above all, it is expressed as a conscious effort to achieve integration through close coordination within coherent industrial conglomerates (keiretsu). This coordination is reflected in large cooperative R & D projects carried out in either distributed fashion or in state laboratories when they cannot be carried out within single industrial conglomerates.

The US position in IT has been eroded by the Japanese, especially in domains such as semiconductors where, to a large extent, it has been following the decline in its manufacturing industry. At the same time in other domains, such as computer systems and packaged software, where the presence of a large and homogeneous home market plays a critical role in giving a valuable lead time and where mass production is not the key factor. IT in the US has been doing very well indeed - US packaged software dominate the world market, and the majority of IT equipment world-wide uses US microprocessors.

It is now increasingly realised in the US that an industrial policy is needed for internal reasons and not only because Japan has had a successful one for some times. The new US administration has emphasized the need for a new technology policy and has stressed the importance of high technology industries. Following President Clinton's election, there is no longer any doubt that a US technology policy will become reality and that the support of civilian and industrial R & D will be coordinated with the promotion of advanced communications infrastructure, technology transfer policy, education and training policy and a stronger trade policy.

Europe is at a cross-roads. Its competitive position has declined from 1985 to 1991 with its IT trade balance dropping from - 9.0 to - 27.2 billion ECU and with high technology accounting for less than one fifth (17%) of European exports, compared with 31% and 27% in the US and Japan respectively. The factors behind this decline have been identified in both Communications from the Commission to the Council and the European Parliament entitled "The European Electronics and Information Technology Industry - State of play, issues at stake and proposals for action" (April 1991) and "Research after Maastricht: an assessment, a strategy" (April 1992). Regarding general technological strength, the conclusions of these communications are that there are strengths as well as weaknesses: the key weakness being in integrating research and technological development (R & TD) and innovation in an overall strategy which both exploits and orientates them.

The strength of Europe in IT lies in its continuing ability to innovate. This ability, however, has translated itself to competitive advantage in a relatively small number of IT sectors - of which manufacturing and software are eminent examples.

- Software has evolved as an art or craft rather than as a scientific or even engineering discipline. This has meant that small companies could engage in its development with relatively small initial capital outlays. This has suited the European economic structure and its SMEs who flourished. At the same time, software and the servicing of a complete systems solution which is often associated with it, has benefited from the need of local contact.

  Current changes, however, are threatening this position. Software is, of necessity becoming more and more, an engineering discipline trying to move away from a craft, in order to be able to cope with the increasing pressure from the market for complex and reliable systems. A persistence on craft practices could spell disaster, while the move to rigorous best practice is a global one and will occur rapidly leading the way to simpler practices to use middleware. If competitivity is to be maintained, Europe cannot persist on craft practices.
- Flexible manufacturing is a recognised strength of European companies and it is interesting to reflect on possible reasons for such strength. One of them is indeed the diversity of the European manufacturing scene and the need to promote standardisation and interworking between automation products of different manufacturers. Whereas a Japanese company can provide advanced islands of automation for a factory it is in Europe where one would have to turn for the most flexible and complete solutions allowing for communications between different kinds of processes and different manufacturers' equipment. Community programmes have played a significant role in this success and the cooperation between suppliers and users of systems in R&D in this area is an example to draw inspiration from.

The weaknesses in IT as in other technological sectors are a matter of strategy rather than R&D weakness. In the field of microelectronics we find, perhaps, the best examples of a weakness which can be overcome:

- Even before the 80s, the European microelectronics industry started lagging behind in some key microelectronic components. The ensuing evolution in microelectronic technologies for digital systems has made it increasingly difficult to catch up.
- Against the background of ever-shortening product life-cycles, increasing financial commitments for fabrication facilities, and more punishing time-to-market schedules, companies, now more than ever, have to decide whether the cost of developing significant expertise in design and fabrication is worth the likely revenues. Chip users have an increasing variety of available solutions and products from a large network of suppliers and only specialist companies can afford to compete.
- The high cost of R&D for advanced silicon chip design and fabrication equipment and the need to reduce time and costs has prompted the formation of world-wide alliances, such as the Siemens/IBM/Toshiba one, and has prompted companies to focus and specialise so that alliances do not become the early steps of take-over.

The trend is reversible – to reverse it a policy for technological renewal is needed and, for the success or failure of this policy, the dynamism and commitment of industry is a crucial factor. Strategic choices will have to be made and for these choices the Community has a major coordinating and catalytic role to play in close cooperation and synergy with European industrial players, large and small.

The Role of Community Policy

Mutations in technology, and especially in the relationship between technology, the market, the economy and society generally must be reflected in Community action to the extent that this is not possible or cannot be carried out effectively at the national level. The Community R & D programmes have been promulgated in the 80s to bring about, through cooperation, the critical mass of a truly European IT industry and to react to the protectionism with which national governments have created "national champions".

There is, today, a tendency to advocate the passage from an excess of protectionism, which can handicap companies, to an excess of despondency and abandonment of action, whose results can be just as bad. This tendency is more often engendered by a non-critical view of the evolution of the markets in the last couple of decades and an incorrect tendency to extrapolate. Tendencies can be reversed and, indeed, if we read the causes of past decline correctly and we see the direction in which Europe is moving, there is every reason to believe that the trend will reverse itself and industrial and Community action takes place in a synergist manner.

On the one hand what is needed today is for industry itself to take its responsibilities and exploit the European capacity to innovate by converting it to products and services. On the other hand is needed a deliberate policy which will allow the different technologies and skills that are essential for growth in IT to come together. These technologies and skills which make up systems, from components to application software to communications, cannot all be possessed by a single enterprise. It is not even possible to encompass all these technologies and skills within the territory of a single European nation.

The role of the Community is thus to enable diversity to be preserved while reacting to initiatives by industry who are clearly in the best position to decide where their best investment may lie. So far, Community policy has tended to concentrate almost exclusively on the R & D dimension and thus R & D has often been used as the vehicle for industrial strategy. It is essential, however, that R & D should be embedded as an instrument amongst others of a broader industrial policy, as explained in both communications of the Commission on industrial policy and its application to information and communications technology industries.

A broader industrial policy for IT would have, of course, R & D policy as a major component. Such policy will consist of a new generation of R & D which guarantees on the one hand continuity of research and on the other hand an effort on those technological priorities on which a broad industrial base relies. At the same time, deliberate measures would be essential to contribute in stimulating demand for IT, in particular through initiatives relative to trans-European networks and standardization.

Besides the strengthening of the market, standardization is a basic tool for the integration and the cohesion of the European market, since it is essential for guaranteeing hardware and software compatibility and the interoperability of equipment and services. European policy in IT consists in providing the development and harmonization of Open System Standards, in the Community and at world level. The European standards bodies CEN, CENELEC (European Committee for Standardization, European Committee for Electrotechnical Standardization) with the cooperation of EWOS (European Workshop for Open Systems) and ETSI (European Telecommunications Standards Institute) that the Commission mandates contribute to support

the European Standardization Structure, which takes into consideration International alignment. Faster standardization and integration of standards into products now become the new challenge to be faced, since products become obsolete more and more rapidly.

Just as a broader industrial policy would address R & D as an instrument of competitivity in a global supply and demand context, and R & D policy would have to look at a broader environment in which it is carried out. The three elements of this environment are above all others and are explicitely mentioned in article 130 G of the Maastricht Treaty as forming an essential part of Community R & D programmes. These are:

- co-operation with Third Countries,
- technology transfer and valorisation,
- human resources.

A fourth important element of the environment has to be taken into account: standardization. Prenormative R & D programmes, such as ESPRIT, RACE, AIM and DRIVE contribute to the preparation and testing of new standards, and feed the European standardization process.

The support for scientific, technological, industrial and commercial cooperation in the international arena can be a positive sum game. This mainly applies to R & D away from the market. Such cooperation, however, is predicated on fair competition and a comparable capacity to benefit from the results of cooperation.

If R & D is not transferred to the market through being translated into innovative products and services or standards, then it becomes a huge global overhead and can do more harm than good if it only benefits one's competitors. In particular, a major problem in postwar Europe has been the excellent quality of scientific and basic technological research unmatched by an equivalent innovation in the marketplace. Industry and academy have been characterised by a considerable divide and academic and industrial researchers have not been communicating adequately either to inform of new developments or to advise of problems in need of solutions. Dissemination of information has a significant role to play, but the most important means of technology transfer has been shown to be through people themselves, essential to the optimisation of R & D to market. Measures to increase interaction between industry and academy and users form, therefore, an essential part of Community policy.

No R & D and no technological advance can take place without the skills of a highly trained workforce. Skill shortages are felt at all levels of the production process. From the researchers and innovative engineers through the technologically literate managers to the operatives of modern manufacturing plants. The effort has to start at the primary school and each European country, aware of the problem, can attack it at the national level. At the European level, a considerable amount of work needs to be done, especially to ensure mobility, and for those skills that are predicated on interdisciplinary and therefore of the coming together of complementary skills present in the member states, and in particular for a new generation of researchers, system engineers and managers of change.

Recognising R & D as one aspect, albeit an important one, a broader technology policy can have a major impact on the effectiveness of Community funded R & D. Any Community policy, to succeed, must be realistic and natural.

To be realistic, Community policy has to recognise that spreading its resources too broadly, though often a good way to promote academic excellence, rarely contributes to breakthroughs that reach the market. The technologies

of the twenty-first century do not come cheap. Unless critical mass is achieved concurrently in research, in the necessary human resources, as well as in capital investment, we would be left without these technologies.

At the same time, a Community policy must be natural. A natural economy reflects the fact that real wealth is earned the hard way through manufacturing competence. The political, legal, financial and service sectors are overheads. However necessary, these overheads must not be allowed to grow to a point of stifling real achievement and wealth creation.

Wealth creation being the objective of the economy, innovation is the driving force behind it. A vision of the future technologies is no longer a luxury but a necessary anticipation, just as necessary as the ability to manage change while it happens. While Community economic policy must emphasize manufacturing competence as the cornerstone of growth, Community industrial policy must emphasize key components; speed to market and integration of quality with volume production.

For innovation to turn into wealth, an additional factor is an appropriate economic and financial environment. Contrary to the US where technological innovation often originates in new companies (start-ups), such companies are not favoured by the European financial environment and strategic actions have been mainly aligned on the large and established ones. The key for the success of a European technology policy must be the encouragement of the emergence of a healthy business environment favourable to start-ups and small and medium size enterprises (SMEs) generally. For the first time, the 4th Framework Programme for R&TD proposes the concept of a valorisation fund to permit ideas to turn into products, with SMEs and start-ups as the main direct beneficiaries.

The cost of capital is generally higher in the Member States than in US and Japan. For IT companies which expand about 20% of their turnover for RDT and investment, such differences create effective competitive disadvantages for European companies.

For R&D, an investment contributing to wealth creation, key to a natural Community policy is the resonance between such policy and industrial needs. Key to such resonance is the bottom-up approach of a policy which is expressed through a timely response to industrial initiatives.

A realistic and natural Community policy must respect the principle of subsidiarity. Respect of the subsidiarity principle must be reflected not only on the kind of cooperation promoted but also on the specific technologies supported focussing on those where concentration of effort and interdisciplinary are keys to success. Unless subsidiarity is respected, the result is an unnecessary bureaucracy and an overhead.

Community Action in IT R&D

Community action must be able to adapt to changes, while at the same time ensuring a stable long term environment for R&D. There are two kinds of changes:

- Change in the relationship between technologies and the market.
- Change that results from advances in technology: a particular technology showing promise or even being the mainstay of industrial production may become rapidly obsolete as a result of either a breakthrough in a competing technology or a change in user requirements.

We are undergoing a major change of the first kind through the evolution in the competitive position of European industry and the increasing role of information technology in the economy and society. This change makes it essential to refocus from Community R&D programmes whose main aim was to foster European cooperation and the achievement of critical mass, to one aiming at well-focussed actions in areas which are strategic for the long term interests of Europe.

In reorienting its activities, within the context of a global policy, the Commission would take into account the need to combine continuity and novelty in its R&D programmes.

The continuity element relates to generic long term research. This is essential to ensure that the R&D that underpins industrial breakthroughs is fostered while at the same time maintaining a healthy European community of researchers. Continuity, however, must not be confused with coverage which is too broad, having a watercanning effect. R&D would need to be focussed onto strategic areas selected for their longer term industrial effects. Thus whereas each individual area of R&D would be highly focussed, the more upstream it is positioned, the longer term its relevance. It is the chaining of such action that ensures both continuity and a more appropriate path for technology transfer.

Continuity measures, however, must be accompanied by a more flexible method of organisation. Responsiveness, adaptiveness, courage to stop what leads nowhere and start what could not have been envisaged far from being incompatible with continuity they are essential for its survival.

Novelty is essential in the Community programmes themselves to ensure the timely exploitation of innovation opportunities. A first step to a policy that combines continuity and novelty is the identification of a relatively small but key elements for the advancement of information technology in the foreseeable future. These thematic domains would provide a framework within which all Community action would have to be situated – a framework which, in itself would have to be reactive and adjust to technological change. Such domains have been identified and would form the next framework of Community R&D effort. Incorporated in these domains is included R&D and standardisation activities relating to CMOS components, RISC-based microprocessors systems, advanced microsystems, software best practices, high performance computing and networking, advanced display technologies, advanced network infrastructures, including far distance learning and information exchange, IT platforms for the integration of manufacturing functions and integrable advanced robotics systems.

Continuity measures take into account the need to foster basic IT research of industrial relevance in order to provide the scientific knowledge and technological expertise needed for underpinning industrial breakthroughs in IT while at the same time providing the nursing ground for future academic and industrial researchers. Long term applied interdisciplinary research projects, upstream from industrial R&D will be undertaken while, characteristically, the nature of each project would be such as to feed several application areas with opportunities for further development. The formation of thematic networks of excellence would complement basic research activity by fostering stronger links between industry and academia, ensuring better training and technology transfer and providing a framework for coordination of R&D.

In a Community programme which is natural, Community funded R & D should never be seen as a purpose in its own right. Instead, cooperative R & D is worthwhile only if it is completely integrated with the mainline policy of the participating companies. If it is not then it is just an unnecessary overhead.

The developments which are most strategic to individual companies are not, for their most part, carried out through cooperation, especially when Community funds do not approach critical mass. This has often meant missed opportunities through lack of either adequate funding or adequate complementary capabilities. At the same time it has meant that cooperation and Community funding have been applied to those projects that have been considered by their companies as less strategic. The reasons for the reluctance of companies to place their strategic R & D projects on a Community funded cooperative basis are often easy to explain:

- Establishing cooperation is a timely and costly procedure which often needs to be carried out in complete confidentiality. Once established, it needs to be carried out with lightning speed. A cooperation agreement, once reached, cannot always wait for the next call for proposals to materialise, nor can industry be expected to each cooperation agreements for meaningfully strategic projects within the deadlines imposed by individual calls.

The result is that Community funded R & D has been restricted to the support of research which is pre-competitive or prenormative, whilst R & D which is closer to the market has been avoided because this would only be worthwhile if the commitment of European companies to exploit its results were forthcoming. The lack of commitment to exploitation associated with projects which are not strategic thus results in a vicious circle.

A way out of this vicious circle is offered by the willingness to develop the new concept of Priority Technology Projects (PTPs), which it should be better to call focussed clusters: they consist of clusters of projects focussed on the achievement of R & D activities related to generic technologies. These clusters of projects should involve companies, in particular SMES, R & D Centers and users. They would contribute to the strengthening of vertical and horizontal partnerships between big companies and smaller ones or between technology advanced regions and less advanced ones. As such, they should provide a structural and cohesion tool.

Of course, the Community support of such clusters is justified by the generic nature of the R & D projects they represent. It cannot be a support for the development of a marketable product but for the development of a technology that will influence many industries and not favour an individual industrial sector. IT, by its pervasive nature, is the battleground for many such generic technologies and for that matter, is likely to be the domain in which most focussed clusters would be launched.

Of course, due to the very nature and importance of such clusters, it is more important than ever to ensure that the results of the R & D end up being exploited in the marketplace. For this the commitment of the proposing companies is essential at the highest level, and this must be accompanied by concrete action - a mere declaration of interest in the results, cannot be adequate. Concrete action can be expressed in the form of visible joint ventures, commitment of substantial funds for eventual production and a single joint management of the project.

This new form of projects complements the continuity measures in ensuring that the Community programmes act in a natural and catalytic way, making it possible for partnerships to emerge where there is genuine convergence of economic interests.

Transparent Community Action Through Subsidiarity

Two aspects of Community action are essential, not only to comply with the current feeling about Community action generally, but to be able to cope efficiently and effectively with a technology that evolves as rapidly as IT. These aspects are transparency, which contributes to a clear and coherent policy, and subsidiarity which ensures that the overheads in coping with an expensive technology are minimised.

Transparency implies a simplification of procedures and the best way to ensure it is the broader participation of the R&D community in the planning process. The long-term plans of the Community must be clear and well understood. On a technological basis, a long-term plan is essential: not a long-term plan of R&D tasks, which would be self-defeating, but a long-term plan of industrial objectives with needs to be solved through R&D. Both the objectives and the R&D needed to meet them would need to be revised on a continuous and independent basis.

The networking of the companies through agreements or alliances, and of the industrial and academic communities around long-term technological goals is one means of achieving a long-term plan that emanates from the industry itself and which is updated by those who carry out the R&D themselves. The close cooperation between the Community and the networks of excellence already being set up achieve such dynamic planning and coordination would be further reinforced.

Information Technology in Europe: The Industry's View

Bruno Lamborghini, President of EUROBIT

1. As history quickens its pace and the world searches for a new international order, the European Information Technology Observatory (EITO) comes into being at a delicate time. Uncertainty and change dominate the international scenario.

Elimination of East-West barriers, pressure of technological progress, market integration and social growth have generated a series of endless transformations with highly visible repercussions for the European integration process and the growth of the IT industry. Many observers say, Europe, as well as the computer industry, has been responding to a severe crisis, but perhaps a transition to a profound change in growth mechanisms would be a more appropriate term.

Although progress may have stalled, a single Europe must be our goal. The integration process has to proceed because most Europeans want a united Europe and because this has become a necessity for technology, business and markets. How and when this goal should be achieved requires consideration.

The same is true of the IT sector. The recent difficulties experienced by the market and the industry are related to the changes taking place in the sector's growth mechanisms, not to a situation of maturity and structural decline.

The EITO intends to monitor closely these market changes since information technology has a strategic importance for Europe. By offering an opportunity to boost efficiency and competitiveness and by improving services and the quality of life, information technology can provide valuable support in generating integration and synergies within the European system. Closer analysis of changes happening in Europe's IT industry and IT markets can therefore impact beyond the IT sector itself. A better understanding of information technology in Europe facilitates a better understanding of problems, opportunities and prospects for Europe as a whole. This is the contribution the EITO intends to offer.

2. After recording annual growth rates of more than 15% for most of the 80's, the 1991–92 IT market expanded by just 3 to 4%, while a sharp decline in the level of demand occurred for hardware products. The recessionary '91–'92 economic cycle intensified the effect of restructuring in the information technology sector which includes computer systems, peripherals, datacom products, hardware and software maintenance, and software and IT services. For hardware products, strong growth gave way to sharp decline in the level of demand.

A slow-down in demand caused by cyclical trends is not the only change which presents itself for the industry. A series of structural factors have transformed the actual economics of the business. These widely discussed points need only a brief outline.

- Technological progress, which brings continuous improvements in price/performance ratios. The downsizing phenomenon has spurred the development of a consumer market. More than 25 million PCs were sold worldwide in 1992 which represents a 25-fold increase of installed world-wide processing capacity from 1983 to 1993. Today, not technology but the user determines the market.
- The growing success of open systems based on industry standards. This lies at the root of the current computer "commoditisation" and standardisation trends which have lowered entry barriers and increased the number of PC manufacturers. Competition therefore no longer focuses only on technological innovation but also on price and service.
- A lower degree of vertical integration, bringing substantial structural changes. Segmentation and specialisation in particular phases of the IT added-value chain has strengthened suppliers of basic components and hardware and software technologies on the one hand and distribution and service units on the other;
- The barycentric shift from hardware to software applications and services. In '92 software and services have accounted for an estimated 56% of the European IT market.

Although this is not a complete list of transformations affecting the IT sector, it does explain two major trends. First the slow-down in demand mentioned earlier and the extraordinary drop in prices of many products, not just hardware, while benefiting users, has eroded company profits. The second concerns the growing differentiation among the various segments comprising the IT market.

Currently the information technology industry does not function as a single market, but as a number of markets co-existing where varied products or services are sold under differing conditions to users through various distribution channels.

Some of these markets enjoy strong growth; others decline. Price competitiveness remains a decisive factor for some products, while functionality is the key element for others. Competitor rankings and company strengths also vary from one market segment to another. With strong pressure on profit margins, companies focus resources on areas of excellence. Since IT presently does not have a uniform global market and many vendors do not have a high level of vertical integration, they tend to specialise and concentrate on a particular niche in the added value chain.

3. These considerations suggest the IT industry is undergoing a painful transition, but it still is a long way from the saturation point. The various market segments differ in stages of growth – some maturing, others still in their infancy. But the next few years could stimulate economic growth for IT with strategic economic benefits for the entire European system. First, since the economy and society proceed irrevocably toward an information society model, huge areas still exist where IT products and applications have yet to be introduced.

A series of obstacles including unresolved technical problems, product diversity and proliferation of standards impede progress. Also the discrepancy between rapid growth in hardware capabilities and slower growth for software and applications indicates the reluctance of users already having equipment and programs to change and innovate.

But despite these difficulties, computer utilisation will improve greatly in the not too distant future. Two primary factors only partly dependent on technological progress will probably trigger this quantum leap. New network infra-

structures will gradually expand and offer broader services. Today, networks are limited, both in geographic terms and in the types of services and functions they provide. These large, innovative network infrastructures make greater integration possible and encourage new applications and new markets. Computerisation will move into a new dimension.

The second factor relates to advances achieved in mobile systems, which, combined with the opportunities opened up by multimedia technology, will stimulate development of personal, global communication. This market has not yet been clearly identified, but its potential carries enormous growth, because the IT industry, telecommunications and consumer electronics will converge and interact.

4. The European market presents many special characteristics because forty different nations speak about thirty languages. For many years the two opposing blocks and market fragmentation were Europe's weak points. The end of the cold war and move toward the Single European Market have transformed the situation. Today, a single large market is not just a vision. But Europe is still beset by fragmentation. At times, with exploding regional forces, the move is to more fragmentation rather than toward integration. However, the tendencies are geared to eliminate barriers and create one enlarged European economy.

Being the largest and most divided of all the world's markets, Europe with differences in language, culture, customs, economic regulations and structures offers information technology a unique challenge. Intelligent development of computer networks and innovative infrastructures will give fresh impetus to the market integration process and create new growth opportunities. The world regards the European market as a leader in IT applications and services. It has high growth potential given European integration requirements and the low level of computerisation in Eastern Europe.

5. Many factors instill confidence in European IT market recovery. Nevertheless, current changes create problems which can only be overcome if action occurs simultaneously at two levels:

- companies must concentrate on developing appropriate strategic and operating responses;
- the European Commission and national governments must define and implement correct measures for market development.

Today, production levels in hardware, software and services fail to keep pace. At the level of demand, Western Europe accounts for 36% of the world market, but in terms of production, Europe's share drops to 27%. Only 76% of Europe's demand is met by European production (IT hardware, software, services, maintenance and support). The percentage would drop dramatically if only production from companies headquartered in Europe was considered.

For hardware products, the share of European demand satisfied from European production falls to 67%. Price competitiveness in hardware production relates directly to efficient manufacturing operations whose location allows significantly lower labour costs and capital costs besides other determining factors.

In software and services, Europe's share of world production nearly reaches its share of world demand. The majority of software products and business services rely on relations with the user and require production locations near market outlets. Since software and services account for a rising proportion of the European IT market - more than 56% in 1992 compared with 32-33% ten years ago - Europe's share of

world production may increase in the future. The industry's shift toward software and services tends to strengthen Europe's position.

But trade figures which refer chiefly to hardware parts and products presented a heavy trade deficit of ECU 20 billion in '91, and preliminary data indicate they worsened in '92. Companies have responded to this difficult situation with stringent cost controls, restructurings, factory closures and reorganisation, job cuts and relocation of low-tech manufacturing to areas having lower labour rates. At the same time, they continue to dedicate greater resources to innovation, to greater flexibility, to product development cycles and to time-to-market. By gearing their development and production toward specific product areas, many companies have increased distribution channels.

Adjusting to new market conditions incurs more expense for companies having a higher degree of vertical integration and a more complex organisation. The smaller companies, begun during the 80's and unhampered by the need to protect and serve an existing base, have found it easier to convert to the new game rules.

Alliance strategies aimed at creating partnerships with companies both in and outside Europe appear ready to play a crucial role in the future IT industry. By forming a balanced network of alliances, companies can build a global presence and increase global production. Only company partnerships linked through a balanced system of alliances will possess all the necessary technological, economic, sectorial, cultural and local skills to grasp opportunities emerging in the new IT markets.

6. Correct strategic plans and operational decisions do not ensure that European companies will succeed in the current industry transitions. Intelligent use must be made of economic and industrial policy tools. These policies must be a balanced mix of different instruments to invigorate demand and create opportunities for new applications.

a) A new wave of investments would stimulate innovative pan-European infrastructure and services. For some time, the European Commission has been discussing ways of encouraging major investments in trans-European networks and technological innovation particularly in the IT sector. This would achieve these goals:

- revitalise the market unification process. To develop the world's largest IT market would be a challenge for IT suppliers having complex information flows to so many countries with differing languages, regulations, etc;
- improve the quality of life for European citizens;
- provide new opportunities for IT companies in Europe. New network infrastructures would increase demand for IT products and services and in addition, would reduce the time required to advance new phases in business and personal computerisation.

A system of trans-European networks would align European policy with that of the new U.S. administration. President Clinton has clarified his intent to support America's high-tech industries through a massive program for the renewal and improvement of infrastructures.

b) The European Community and the national governments must endorse principles of free international competition under equal conditions. The only favourable environment is an open, not a protectionist one. The IT market should be a truly global endeavour characterised by a high level of international labour mobility.

Therefore, the IT industry must have unlimited access under fair trade conditions to any market. Subsidies do not improve competitiveness. No industry relying on state subsidies can compete at either a European or global level.

The following items must be stressed:

- At a time when competition is strongly cost and price sensitive, free access to state-of-the art semiconductors with prices identical to those available to the U.S. or Japan is vital in order for the European IT industry to be competitive. This must be assured for recovery.
- A truly liberalised consumer market ensures free competition. Since public procurement accounts for more than one fifth of IT demand in Europe, it has proved a valuable tool in encouraging development of innovative products and services for IT infrastructure. Common, open standards would also be accelerated and defined. Although a highly effective industrial policy tool, public procurement must not be allowed to create market distortions or unfair competition.

c) In addition, government action should focus on training and R&D policies:

- Training should be an area for urgent action. The new U.S. administration considers training a top priority; Japan dedicates a huge volume of resources to training and produces 80,000 engineers a year, compared to 40,000 in Germany and France. Sufficient training must be provided for all European citizens in order to achieve broader skills among providers of IT products and services and users working with these.
- Europe must also introduce new incentives for technological research and innovation in the corporate sector. Innovative capacity in general and R&D capacity in particular will decide success in the global competitive environment of the 1990's. Europe developed new tools in the 80's to support and promote corporate cooperation in R&D. Not all were successful, but they helped focus attention on innovation and create new opportunities for cooperation.

Recently, Europe's technological innovation policy has declined. Lack of resources and widespread reluctance to explore new possibilities place constraints on national and EC initiatives. This could mark an additional handicap for the industry partly because a technically dynamic environment stimulates development and because the U.S. will adopt industrial policy measures to promote development and application of technology.

d) Accelerating deregulation in European telecommunications would heighten competition and encourage innovation. The break-up of Europe's traditional telecom monopolies would dramatically impact IT growth, enlarging opportunities for new applications and services, reducing costs and encouraging greater integration among computer and telecom services. New businesses would emerge, and new partnerships/alliances would modify the industry structure, fostering new growth potential for IT companies in Europe similar to the AT&T deregulation in the United States. Many other industrial policy instruments could provide intelligent support without risk of creating a protected, non-competitive market. The European Commission and national governments have to play an important role in promoting new growth and innovation in the 1990's.

7. EUROBIT, the European Association of Manufacturers of Business Machines and Information Technology, formed in 1974 as a federation of national associations which includes almost 100% of European manufacturers, strongly supports the development of a European industrial policy for the IT industry. This

industrial policy has to use opportunities created by the Single Market for favourable market conditions and the environment to strengthen the IT industry in Europe. EUROBIT must respond to the challenges involving the political and economic developments in Europe as well as the structural changes in our industry world-wide. Therefore, EUROBIT's activities cover the sensitive fields of economics and politics as well as establishing specific industry positions for all IT relevant issues.

EUROBIT supports the principles of a free economy and private enterprise in Europe and the world. From the very beginning, it attached great importance to the GATT Uruguay Round and has prepared various position papers requesting the world-wide abolition of all duties on IT equipment and parts including electronic components. Also priority is given to negotiations on trade related aspects of intellectual property rights, trade in services and trade related investments. The latter, together with negotiations on tariffs and non-tariff measures, are subjects for further submissions.

On both European and international levels, EUROBIT's Industrial Policy Group (IPG) reflects the growing importance of industrial policy in determining the framework for information technology. With a broad range of responsibilities in information technology, specific telecommunication issues, and for institutions and standards organisations, IPG and its activities cover matters of harmonisation, liberalisation and deregulation, in addition to community initiatives and their effects on the internal market. Special attention is given to technological developments, and conformance testing and certification.

These are only a few examples of EUROBIT's widespread scope of activities which include trade policy and customs matters as well as export controls, IT security, standardisation, environmental achievement, statistics and market research and many others.

8. In 1991–92 the European market and industry were hard hit by the crisis in the IT sector and the outlook for 1993 is not bright. Europe is now the most fiercely competitive area in the computer business. Aggressive price wars and weak or declining demand accelerate major and costly restructurings. So far European companies have not yet taken full advantage from the Single Market. Nevertheless, the medium/long term outlook is encouraging. Even though the European integration process has slowed, it is irreversible. And successful market unification is closely linked to creating efficient, compatible flows of information among various national administrations, companies and institutions.

The Single European Market will be a source of innovative IT application. By accelerating the unification process, a new wave of investments in advanced trans-European infrastructures will improve the quality of life and create new opportunities. Once again a catalyst for change, the European IT industry welcomes the new challenges for growth and global competition.

The Current Information Technology Situation and Perspectives in Europe

1. The European IT Market in the Worldwide Scene

1.1. The Largest IT Market in the World

The European Information and Communications Technology (ICT) business was worth 225 billion ECUs in 1992. Of this, 128 billion ECUs (57%) was accounted for by Information Technology (IT) as such - Office Equipment, Electronic Data Processing Equipment, Software and Services, Hardware Maintenance and Support - and the remaining 97 billion by Telecommunication Equipment and Services.

Unless otherwise stated, all of the market figures and comments that follow refer to the IT business. Europe is taken to be the combined markets of the twelve EC and five EFTA countries: because of their still small size and the relative lack of detailed segment information, the Eastern European markets will not be included in the European market totals and cross segment comparisons.

	1992	% of IT	% of ICT
Computer Hardware	47	37	21
Office Equipment	13	10	6
Software	19	15	8
Services	34	27	15
HW Maintenance and Support	14	11	6
Total IT	128	100	57
Telecommunication Equipment	18		8
Telecommunication Services	79		35
Total ICT	225		100

Note: (*) Europe includes the 12 EC and 5 EFTA countries (Switzerland, Austria, Sweden, Norway, Finland)

(**) It should be noted that all figures have been rounded to the nearest billion ECUs at 1991 constant exchange rates. Totals and percentages may not add up due to rounding.

Source: IDC/Eurobit

Table 1
European (*) Information and Communications Technology (ICT) Business, 1992. Billion ECUs (**)

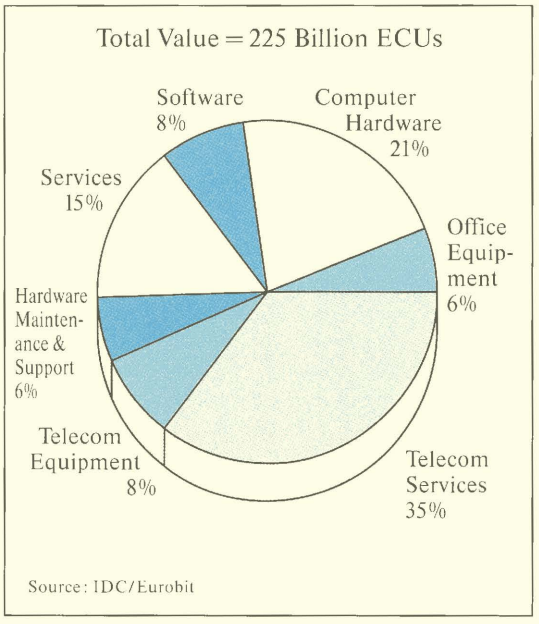


Figure 1
Western European (EC + EFTA) Information and Communications Technology (ICT) Market by Product 1992

1.1.1. Europe as a Consumption Area

The importance of the European IT market is mainly due to its relative weight in relation to the world IT market: in 1992, Western Europe accounted for 36% of total world consumption.

Europe represents the largest concentration of people with high incomes who are prepared to spend on IT products and services. Furthermore, the level of saturation of the European IT market is significantly lower than in the US, leaving considerable room for development over the next ten years when the European market growth rate is expected to exceed that of the US market.

When the European market is broken down into the main country markets, it can be seen that Germany accounts for 23%, the French (17%) and UK (16%) markets are more or less the same size, and are followed by Italy (11%) and Spain (5%). Growth rates in these last two countries are still a little higher than those in France and the UK, partly as a result of their higher rates of inflation.

The recession that has struck some EFTA countries has led to a significant reduction in growth rates since 1989, although this is expected to improve.

The overall rate of growth for Europe in 1992 was 3%. It is expected that, as Europe gradually comes out of the recession, the 1993 growth rate will be about 4.3%.

Europe's main asset is its demand capacity. Whoever wants to do business over the next ten years must be present in Europe in order to take advantage of the combined potential of the market.

However, it is important not to underestimate the particular characteristics of European demand. First of all, demand is going through a period of discontinuity (partially as a result of structural factors, and partially as a result of

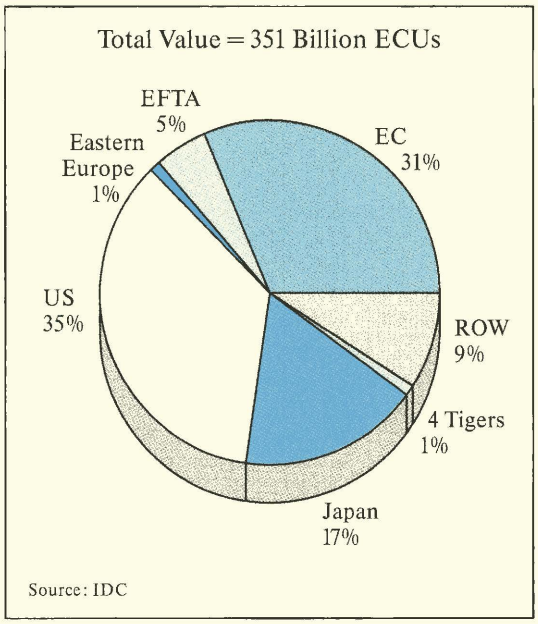
Table 2
Worldwide IT Market Consumption by Region (Excluding Office Equipment): Percentage Breakdown Calculated on Market Values. Billion ECUs

	1992 Value	1992 %	1994 %
Western Europe	128	36	35
EC	110	31	30
EFTA	18	5	5
Eastern Europe	2	1	1
US	124	35	35
Japan	61	17	18
4 Tigers	4	1	1
RoW	31	9	10
Total	351	100	100

Note: 4 Tigers = Hong Kong, South Korea, Singapore, Taiwan
RoW = Rest of World

Source: IDC

Figure 2
Worldwide IT Market by Region 1992



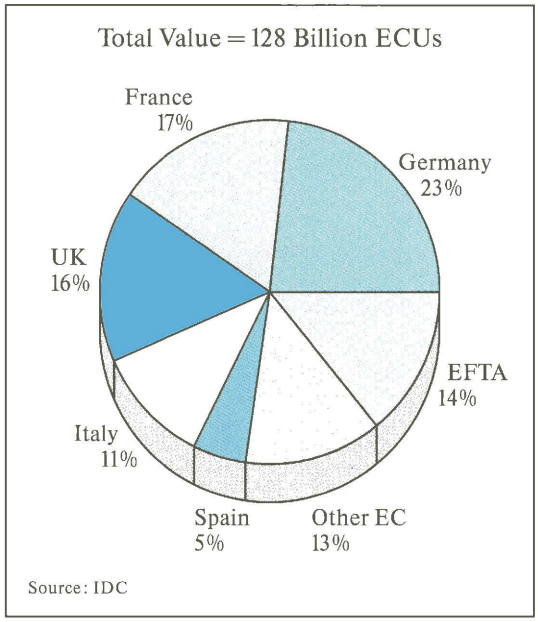


Figure 3
Western European IT Market by Country 1992

	1992 Value	1992 %
EC	110	86
Germany	30	23
France	22	17
UK	20	16
Italy	14	11
Spain	7	5
Other EC	17	13
EFTA	18	14
Western Europe	128	100

Source: IDC

Table 3
European IT Market Consumption by Region: Percentage Breakdown Calculated on Market Values. Billion ECUs

the way in which general economic trends have affected the IT market), and this has led to a slowdown in growth rates over the last two years.

In particular, the impact that the recession affecting the entire continent has had on large-scale investments has caused a certain instability in demand. This impact is particularly significant when we consider that, in an increasingly service-based economy, investments in IT products and services represent a growing and frequently determinant part of total investments.

It would be a big mistake to consider the European IT market as globally uniform. Today, the European IT market is more a conventional conception consisting of the consolidation of very different local country markets and a highly fragmented segmentation in which different products and services are sold under different conditions to different users via different distribution channels.

The real potential of the European market will only be fulfilled when the evolution of this heterogeneous multitude of local markets into a true Single Market has been completed.

Another factor is that the new protagonism of the users is changing the rules of the game which the IT industry has been playing for years. European users are no longer interested in buying simple technologies. Under pressure from an economic recession which has obliged them to struggle for competitiveness, they are increasingly looking for business solutions - and they expect to be able to measure the return on their IT investments. The market is no longer supply, but demand-driven; and the spread of open systems has given users a degree of liberty which is breaking down the old proprietary barriers.

The market is becoming segmented into numerous combinations of customer size, geographical divisions, industrial sectors, application solutions and so on. It is not one market, but

Figure 4
Western European IT Market Actual Growth and Forecast

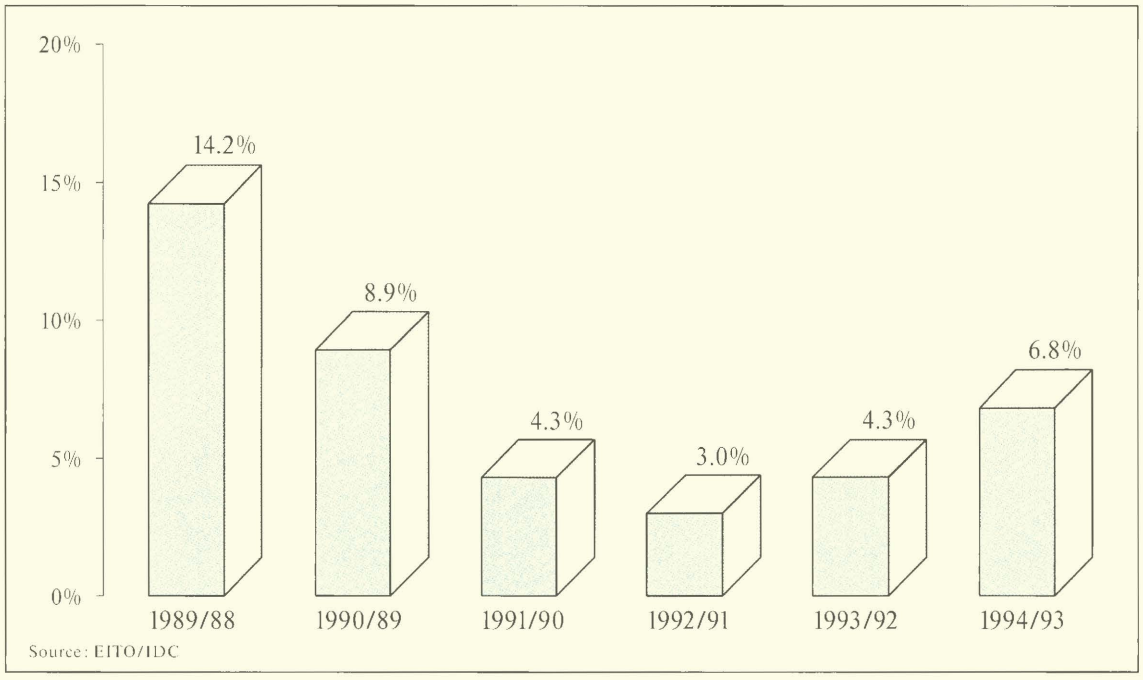
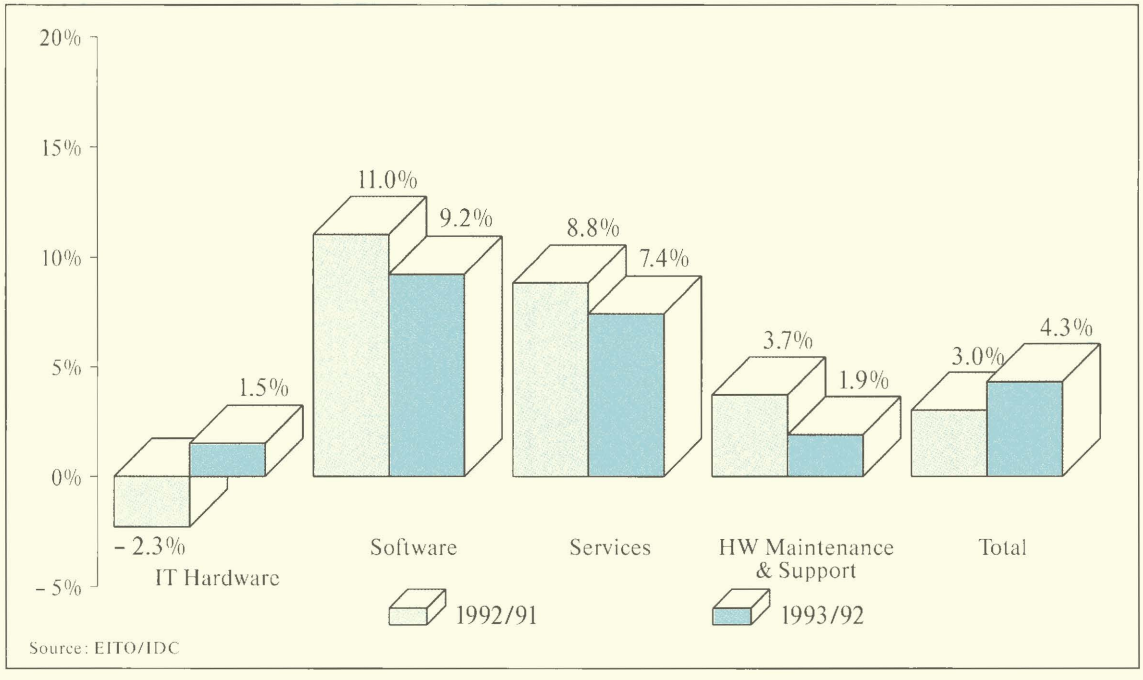


Figure 5
Western European IT Market Value Growth by Product Segments



a large number of markets - some growing and others declining.

Looking at overall average growth rates covering that aggregate which is conventionally defined as the European IT market may provide only a relative understanding, unless it is broken down into a more precise analysis of individual segments and specific market niches.

1.1.2. Europe as a Trade and Production Area

Production

When "system Europe" is considered as the whole set of human and capital resources involved in European-located operations (whether or not the companies have their main headquarters in Europe), total IT production in Europe was worth about 83 billion ECUs in 1992. If all production (hardware, software and services) is taken into account, something like 76% of the EC's market value is covered by European Production.

A very large part of IT hardware and base system software is produced by American firms; non-European players account for a much smaller percentage of professional services which are expected to represent one of the most dynamic segments of the market over the next few years. This, together with the production of packaged PC system software and tools, makes it reasonable to foresee that the value of these activities will increase by more than the average of the market, and it can be expected that European production will soon contribute more than its present 76%.

Although the internationalisation of the European IT industry suggests that it may be more correct to analyse the contribution of European-based activities in terms of added value, the lack of quantitative production information at the various stages following the import of basic components makes this impossible.

1992	Production value	Production breakdown	Production as % of market
IT Hardware	35	42	67
Software	7	9	45
Services	28	34	95
HW maintenance and support	12	14	100
Total IT	83	100	76

Note: The most recent trade statistics used to estimate production are only available for the EC

Source: IDC/Eurobit

Table 4
EC IT Production versus the Market by Segment. Billion ECUs

1992	Production value	Market value	Production as % of market (**)
Germany	10	15	71
France	7	10	68
UK	6	10	69
Italy	5	6	75
Spain	2	4	50
Ireland (*)	2	0	603
Other EC	2	7	31
Total	35	52	67

Note: The most recent trade statistics used to estimate production are only available for the EC

(*) IT HW market value in Ireland = 0.4 billion ECUs

(**) Production as % of market is measured in non-rounded millions of ECUs

Source: IDC/Eurobit

Table 5
EC IT Production versus the Market. IT Hardware by Country. Billion ECUs

As described in Part Three - Statistical Outlook - under "Definitions", the best possible estimate of this breakdown can only be obtained by considering total production in a national market in terms of the relationships between domestic revenue, imports and exports.

For computer and office hardware, the availability of customs data makes it possible to measure IT manufacturing strengths at country level.

Accounting for about 93% of IT hardware, production is more concentrated than the market in the top five European countries. For historical reasons, different European and national industrial policies concerning plant localisations and various forms and stages of industrialisation, mean that the distribution of IT production in these countries is far from being uniform.

Table 6
EC (**) Trade in IT Hardware. Billion ECUs

	1989	1990	1991	1992(*)
Imports	52	53	57	57
% extra-EC	46	45	46	47
Exports	40	40	41	39
% intra-EC	70	70	69	68
Trade deficit	12	13	16	17

Note: (*) estimates for 1992 are based on year to date values as of June 1992
(**) 12 EC countries

Source: IDC/Eurostat

Table 7
EC Trade in IT Hardware. Billion ECUs

	1989	1990	1991	1992(*)
Imports	52	53	57	57
% intra-EC	54	55	54	53
% US	21	18	18	17
% Japan	12	12	13	13
% 4 Tigers	8	9	10	11
% Rest of World	5	6	6	6

Note: (*) estimates for 1992 are based on year to date values as of June 1992

Source: IDC/Eurostat

Evolution of trade

European trade (that is, among the 12 EC countries) is characterised by the dominance of intra-European exports and an increasing dependence on extra-European imports.

Trade dynamics can best be monitored in relation to computer and office machinery. In 1992, the deficit of the European trade balance was in the region of 17 billion ECUs; for the first time for some years, both imports and exports decreased (the latter to a lesser extent).

Extra-European imports have been increasing over the past few years and now account for almost half of total imports. The 4 Tigers (Hong Kong, Taiwan, Singapore and South Korea) have increased their share at the expense of both Europe and the US.

This trend is at least partially due to the progressive localisation of US vendor manufacturing facilities in Europe, which has led to a decrease in imports from the US. In fact, having attracted US players by means of financial and fiscal incentives, the only European country with a trade surplus is Ireland. Similarly, the progressive gain in share of imports on the part of the 4 Tigers is related to the choice of some major European vendors to transfer their manufacturing facilities to these countries because of the low labour costs.

The dependence of Europe on the US is also evident when software and services are considered. There are no official trade statistics for this business, but it is clear from the basically local or European-focused structure of the segment that, although Europe has a significant intra-European export position in professional services and applications software, its dependence on extra-European imports of system software and software tools is increasing.

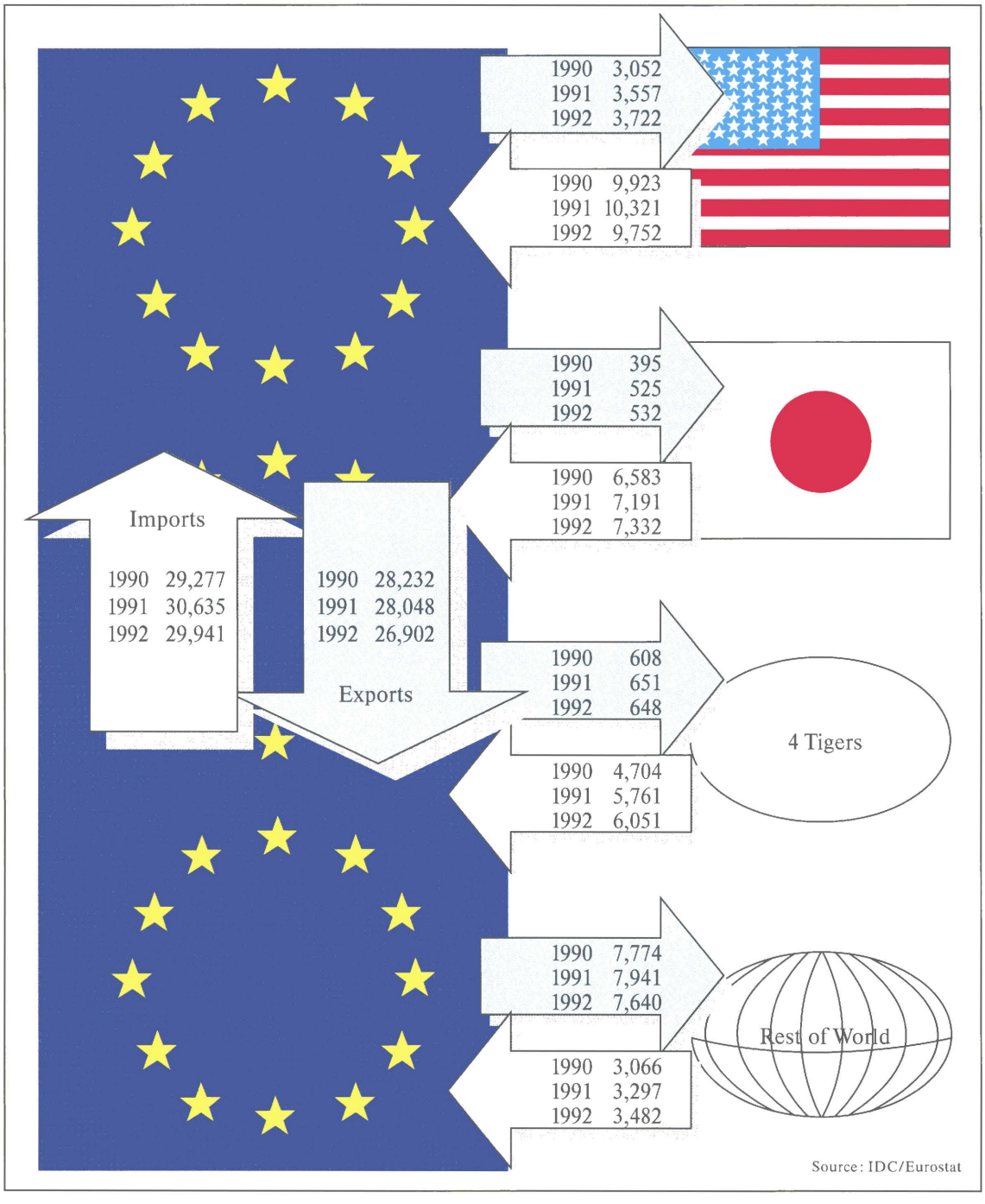


Figure 6
Evolution of Trade in IT Hardware between the EC and USA, Japan, 4 Tigers and the Rest of the World (Values in Millions of ECUs)

Note: Estimates for 1992 Values are based on year-to-date values as of June 1992

1.2. Positioning of the European IT Market

The positioning and potential of the European IT Market can only be objectively assessed by considering its relationship to the IT scene worldwide. It is therefore worth discussing various factors related to the behaviour of the industry itself and to its relationship with the economy.

1.2.1. Globalisation

The process of "globalisation" of the economy in general is the result of the gradual convergence of competitive rules, player coverage and user demand towards a common set of factors. This set defines a new "global" competitive environment that is no longer characterised or influenced by national peculiarities or boundaries.

The effect of the forces working towards the globalisation of the IT market is not apparent at first sight: Japanese companies currently dominate the Japanese market, US companies dominate the US market and, although Europe is closest to representing a real competitive battleground, it is primarily dominated by European and US companies. In this sense, the IT business cannot yet be considered as fully global – although it is worth considering certain criteria in greater detail.

Natural Sizing

"Natural sizing" is the process by which, over time, any country's share of worldwide IT business is likely to gravitate towards that country's share of gross domestic product (GDP).

A convergence of this kind has taken place over the last ten years. In 1981, Europe accounted for 45% of the OECD world's GDP, but its share of the world's IT market was only 33%. At the same time, the US accounted for 35% of the world's GDP but, because of its more rapid development and market penetration, its share of the world's IT market was 49%. Japan's GDP and IT market shares were both about 14%.

By 1991, the share of GDP had fallen to 42% in Europe and to 33% in the US; but the European share of the IT market had grown to 40% (still a little below its GDP share), while the American share had dropped to 38% (closer to its GDP share, but still above it).

In Japan, the significant increase in GDP share (from 14% to 20%) was accompanied by a smaller increase in its IT share (from 14% to 18%), which still has further room for growth.

Ideally, this phenomenon can be described by plotting these relationships on a map comparing the countries' share of the IT business (the vertical axis) with their share of non-agricultural GDP (the horizontal axis). The tendential convergence towards equilibrium is shown by the positions in 1981 and 1991 of each country in relation to the line bisecting the two axes (see *Figures 7* and *8).*

As can be seen from the chart, in 1981, the EC and EFTA countries were positioned under the line, their share of the world's IT market being "undersized" in relation to their share of the world's GDP. Japan is on the line of equilibrium between the two, while the "oversized" IT share of the US places it above the line.

By 1991, both Europe and the US had moved towards greater equilibrium (albeit in opposite directions), while its increase in both GDP and IT share had led Japan to move along the line towards the right.

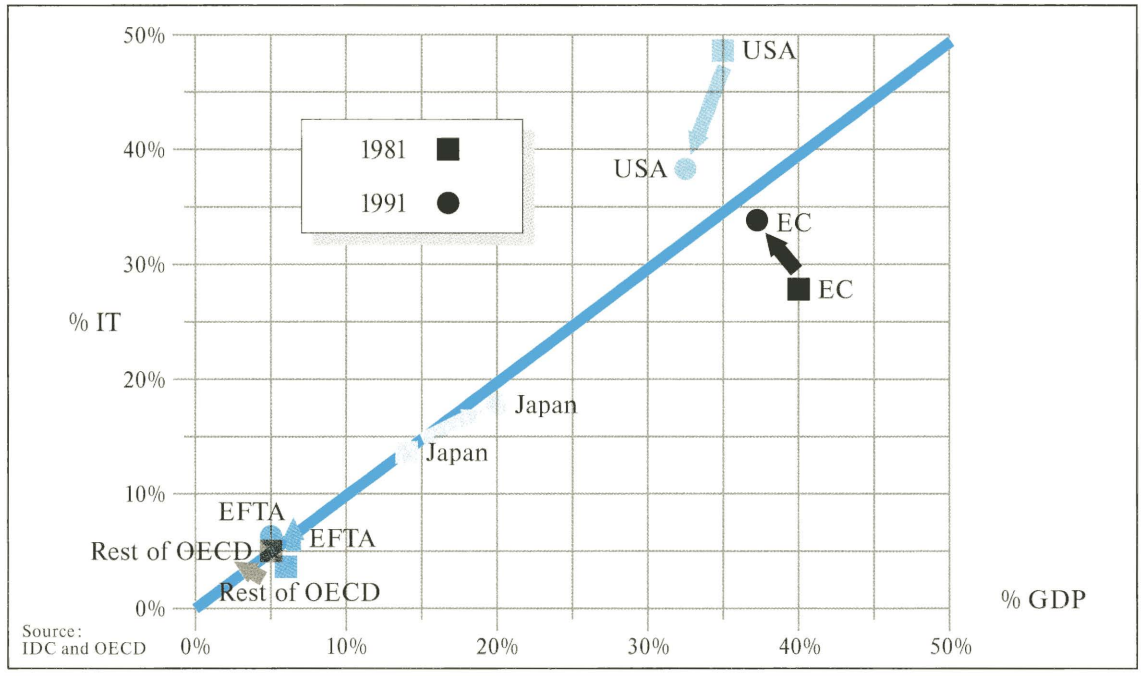


Figure 7
Share of GDP versus Share of IT in Major Regions

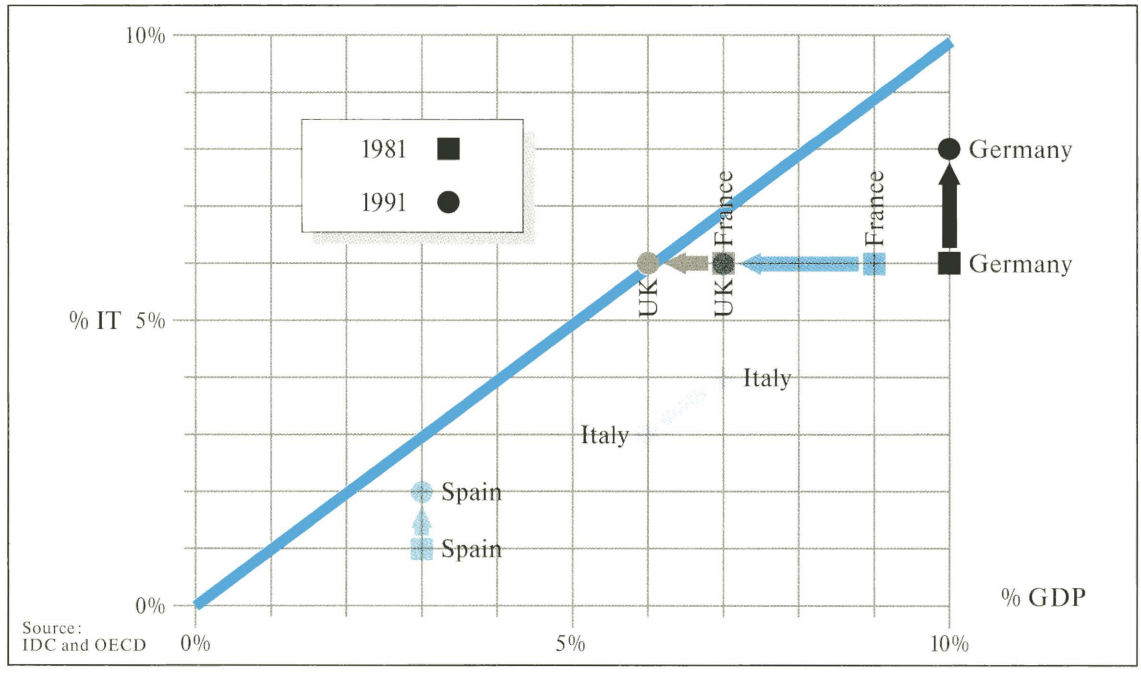


Figure 8
Share of GDP versus Share of IT in Major European Countries

Some differentiation must be made when considering the major European countries. The most saturated market is that of the UK, the European market which (together with the most IT-developed countries in the Scandinavian region) has most felt the effects of the recession. France is not far behind, its short-term growth prospects being lower as its economy is currently going through its negative peak cycle. Germany has recovered a lot in terms of convergence, and the integration of former East Germany offers further room for development. The positions of Italy and Spain still reflect the fact that they were later in adopting new technologies and have a lower IT penetration rate. In particular, although Italy's share of both the IT market and GDP has grown, the gap between the two remains the same (a situation which is similar in the more recently industrialised countries).

Extrapolation of these trends suggests that Europe still has room for growth towards equilibrium, and that the US risks losing further IT market share.

In fact, there is a major difference in the economic prospects of Europe and the US. Recovery in Europe will be strengthened by two factors: the process of market integration will generate more demand and contribute towards a general decrease in cost levels, making Europe more competitive at an international level; the development of Eastern European markets (whose current IT share is less than 1%) will lead to high growth primary investments and improvements in new technologies.

If these two market factors exert their positive effects in the short term, it is reasonable to expect that, like Japan, both IT and GDP shares will grow: the European IT industry has more room for growth than any other region in the world.

Table 8
Percentage Share of GDP and the IT Market of the Major Countries/ Regions Worldwide, 1981-1991

	1981		1991	
	GDP %	IT %	GDP %	IT %
Germany	10	6	10	8
France	9	6	7	6
UK	7	6	6	6
Italy	6	3	7	4
Spain	3	1	3	2
EC	40	28	37	34
EFTA	5	5	5	6
US	35	49	33	38
Japan	14	14	20	18
Rest of OECD	6	4	5	5

Note: EC = the present 12 countries of the Community have been considered for both 1981 and 1991; Germany includes former East Germany.
EFTA = Switzerland, Austria, Sweden, Norway, Finland.
OECD = EC + EFTA + US + Japan + Canada + Australia + New Zealand + Turkey.

Source: IDC, OECD

Market segmentation

The IT market is really many markets in one. As a result of the emergence of particular competitive rules, economies of scale and demand patterns for different products and services, there are many differences between one segment or target and another. Consequently, the picture of globalisation becomes mixed, expecially when comparing the business related to IT hardware and basic software products, and the business related to particular software applications or IT services.

Today, many products are global (e. g. microprocessors and personal computer operating systems), but there are no global application software providers and no global services industry – this business remaining very local.

Alliances

The process of globalisation also manifests itself through equity alliances and partnerships which contribute towards spreading new technologies and services across markets and types of user. Depending on their objectives, different kinds of alliances can be identified: *alliances made to broaden product market access, technology alliances* aimed at achieving R&D synergies for common basic technologies, and *alliances for innovative offerings* designed to enter new markets by providing integrated products/services.

Albeit to a greater or lesser extent, all of them have global implications as their increasing geographical coverage leads to an increasing convergence in the market behaviour of the players.

The rules of trade

The final way of looking at globalisation is in terms of the currently prevailing trading environment.

In Europe, the prevailing attitude is in favour of the liberalisation of the trading environment, coupled with strong support for R&D cooperation and the standardisation of infrastructure investments; both the US and Japanese trading environments are characterised by aggressive export policies. This approach may be countervailed by the emergence of bilateral agreements and managed trade between the US and Japan, the two largest producing countries in the world.

A crucial role in setting and monitoring the rules of trade in Europe is played by the policy of the EC (Directorate General XIII for Information Technologies and Industries, and Telecommunications). Over the past few years, DGXIII has favoured joint R&D (through such projects as ESPRIT, RACE and Telematics), the opening of markets, cooperation among leading ICT companies in high-cost basic technology developments, and the liberalisation of IT and public telecommunications procurement. The overall objective of its policy is to create a common European ICT market where all players can compete on an equal footing and have the same awareness of market rules and user requirements.

This choice of a partially funded, but basically indirect "hands-off" industrial policy towards the European ICT industry (as compared with the more inward-looking policies prevailing in certain third country markets) is related to the objective of strengthening European operators by offering them equal opportunities and fair competition in the markets where they operate. The overall result is a widening of European IT market boundaries, both geographically and in terms of product integration.

1.2.2. Consolidation

Although there are clear signs of consolidation in the IT industry, it is still difficult to assess as there also exist countercyclical forces neutralising the process.

Hardware

Consolidation is at work in such areas as *office products, low-end printers and personal computers (PCs).*

There are now about 1,500 PC brands currently marketed around the world. This is a consequence of the high margins policy of the first entrants in the PC market, which created a broad price umbrella under which newcomers could easily find profitable business simply by overcoming low technology-related entry barriers. The standardisation of the PC offer and the consequent development of price pressures have led to highly price-sensitive purchase attitudes. This will gradually eliminate the conditions that made it possible for large numbers of relatively small suppliers to survive on the market.

Other changes in user attitudes are driving the spread of distributed computing as a new way of enabling information systems to manage applications more flexibly. These have led to the development of a new role for PCs and multi-user systems. Together with Unix workstations and PCs, large-scale systems are being turned into commercial "server platforms"; it is likely that medium and small-scale systems will become more similar to network servers as they continue to be repositioned, with low-cost technologies and PC connectivity.

The process of shifting computer power towards end-users, and the consequent repositioning of traditional systems, is driven by three main factors: the use of smaller networked platforms is adding more users to the information system; the application and processing demand of existing users is increasing; new applications are being added to the system.

Electronic mail technology is gradually evolving towards a PC LAN-based topology which is destined to lead to a wide variety of messaging technologies, once new applications such as "workflow" software and conferencing facilities are developed (and PC application software features mail capability as a utility).

The integration of applications and databases is likely to have profound effects in all vertical markets. Computer integrated manufacturing (CIM) is an interesting example in its support for intercompany information flow, linking suppliers, distributors and other channel participants. Greater user sensitivity to the advantages of such systems (and the ability to use them), as well as the upcoming supply of open architecture software, will further encourage these developments.

These have led, both in Europe and in the US, to some consolidation in the *medium-scale computers* segment (which found themselves being squeezed between PCs and the new lower-priced mainframes), and in *the mainframe* or large-scale systems segment, where only a few of the original major players now have the appropriate economies of scale. An increasing number of new players have been successfully approaching the business of high-end systems, either in market niches or in competition with traditional suppliers, and so the total number of players in this segment also remains relatively stable.

The overall impression is that the multi-user systems business has already completed the process of consolidation, but there remains the key question of the opportunities that still exist in the supply of standard basic chip technology. A number of vendors use other manufacturers' microprocessors at the core of their hardware systems; the more widespread the acceptance of this basic technology, the higher the return on the development investments of the manufacturer. The next few years are likely to see a tough test taking place as to how feasible it may be to differentiate standard core technologies in order to gain access to the market with premium prices. A few players would be clearly successful, and the same sort of selection as the one occurring in the PC business is expected.

Software

An apparent consolidation of the software area has taken place, leading to the predominance of the large suppliers of systems/utilities and tools. But it is being driven by two divergent economic processes: software development continues to reap no benefits in terms of economies of scale and is generally still best done by a small groups, but the marketing and selling of software is much more economic when done by large organisations.

This type of tension is not unusual. The publishing, TV and record industries make use of relatively independent authors and/or production functions, but market their products through larger scale entities; and this might provide a useful model for the PC software market in the long term.

As in other sectors of the economy, the number of developers and engineers producing and authoring software could increase rapidly as a result of the increasing availability of object-oriented technology facilitating software development on the part of independent developers and the existence of low-cost skilled labour (especially in the Eastern markets).

As software and services now represent more than 50% of the total market, reference is made to the separate section that has been dedicated to it in this volume.

Services

Services are also characterised by countervailing trends, in terms of business size and in terms of the type of services offered.

Growth in the demand for global services is countervailed by significant diseconomies in supply, thus making it possible for many small businesses to survive at a local level. This explains why the existence of global accounting or consulting companies doesn't preclude the long-term existence of a large number of local companies.

The emergence of an external supply of services which users have traditionally carried out internally, or which are required after the adoption of new technologies (the design and planning of Information Systems, network integration and management, multiple hardware maintenance), is countervailed by a decline in traditional services (data processing).

1.3. The Peculiarity of the European IT Market

The current worldwide picture of the IT industry shows that globalisation is at work (albeit as a result of different forces) and that consolidation is under way in selected segments.

The European IT market stands out as the largest market with clear growth potential and with the most qualified and sophisticated user community, making it the real battleground for ongoing consolidation.

It is this which lies at the basis of the *peculiarity of the European IT Market.* Despite its size and growth potential, Europe is currently facing a period of discontinuity in the process of globalisation due to factors which go beyond the general economic recession.

This means that IT vendors interested in operating on the European market must learn how to deal with the discontinuity and instability of European demand; learn how to operate in a multiplicity of national markets, segments and niches moving at different speeds (because the Single European Market is still in the process of completion); and understand that the European market is no longer technologically driven, but demand pulled.

The key success factor in this variegated multiplicity of sub-markets consists in the ability to understand the specific application needs of the users and the control of the expertise necessary to satisfy them.

2. Current European IT Market Trends

2.1. Recent Trends and the Current Market Situation

As indicated in Chapter 1, Europe is already the largest potential IT market in the world. However, after having experienced growth rates during the second half of the 1980s which were significantly higher than those of the US market, annual growth suddenly started to fall in 1990 and dropped to 3% in 1992.

Table 9
Western European IT Market Actual Growth and Forecast

1989	1990	1991	1992	1993 (E)	1994 (E)
14.8%	8.9%	4.3%	3.0%	4.3%	6.8%

Source: EITO/IDC

Despite this apparent setback, Europe will remain the largest area of IT business opportunity over the next 10 years because of the size of its potential IT purchasing population. It is therefore necessary to understand the causes of this discontinuity in growth, and identify which of them are the result of the general slowdown in the European economy and which are a reflection of structural changes in the IT sector.

2.2. Growth by Country

Table 10
Western European IT Market Growth by Country. Billion ECUs

	1992 Value	1992 %	1993 %	1994 %
EC	110	3.4	4.3	6.7
Germany	30	4.7	5.5	6.5
France	22	1.6	2.0	5.7
UK	20	1.2	2.9	5.8
Italy	14	4.6	4.2	5.6
Spain	7	5.3	5.9	8.8
Other EC	17	4.7	6.2	9.4
EFTA	18	0.7	4.1	7.4
Western Europe	128	3.0	4.3	6.8

Source: EITO/IDC

The future of the European IT market is largely related to the evolution of Germany's IT market (which represents about 30% of potential European demand). The reason for such a large market is that Germany is a country where automation and technology have been viewed positively for a long time. Reunification and the opening up of the Eastern European market provide a number of opportunities for growth. Germany's great strength lies more in process innovation than in product innovation. It is particularly strong in design, CIM and other industrial applications for the chemical, engineering and automotive industries.

In 1992, *the UK* started to show some signs of recovery from the worst crisis that it has ever gone through. Despite continuing economic uncertainty, it is still a highly competitive market and growth should begin to pick up further.

The recession which has already been affecting the UK for some time, hit *France* a little later - consequently, growth in 1993 (2%) is not expected to be much higher than in 1992 (1.6%). Other factors affecting growth are close Government control over the economy and the same cautiousness in user attitudes existing in other countries.

Italy will not recover from the problems currently afflicting it until 1994, when the effects of Government measures should begin to be felt. Furthermore, because of its urgent need to reach the economic levels required for entry into the EC's unified market on an equal footing with the other countries, State and local government spending (as well as cost cutting) will be controlled.

Spain's growth is partly a reflection of its rate of inflation, but it is also true that its existing low per capita expenditure on IT makes it a country offering a great opportunity to the industry.

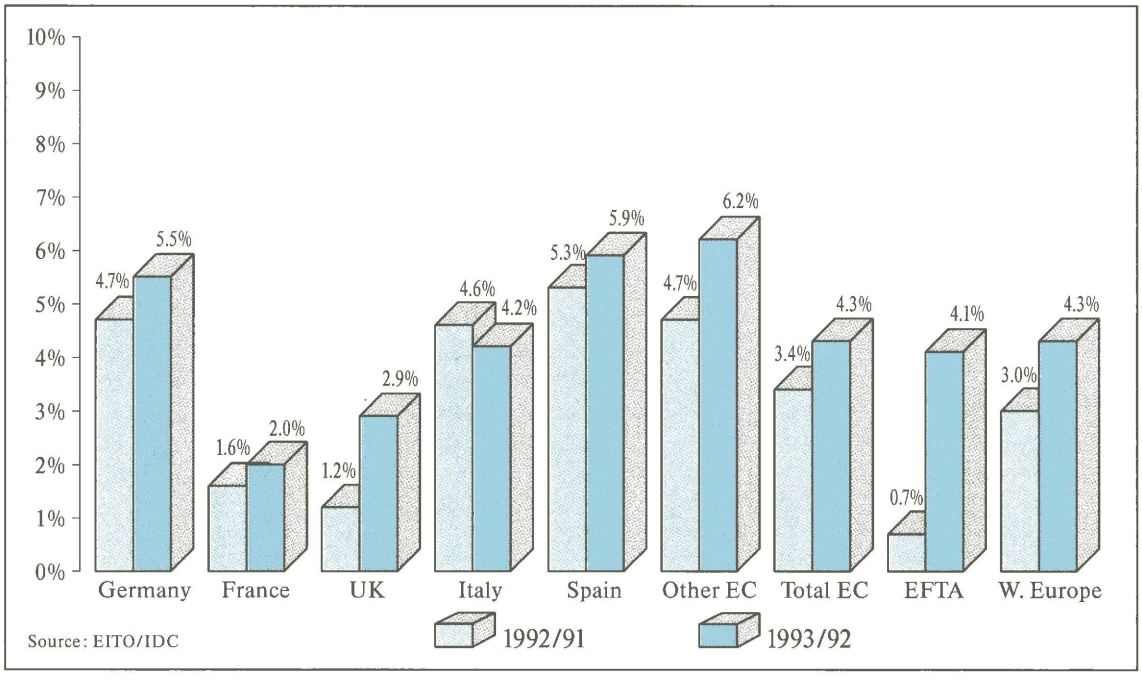


Figure 9
Western European IT Market Value Growth by Country

2.3. Products and Vertical Markets

A better idea of what is happening can be obtained by breaking down the market into product segments. The most significant factor is that the hardware sector (both office and EDP systems) is suffering more than the software and services sectors.

Large-scale systems were most affected between 1990 and 1991. Their 10% negative growth rate was mainly due to the impact of the recession on the propensity of users to invest in large-scale capital assets. The slight improvement in 1992 is a reflection of the success of top vendors in selling technologically updated product families which have been welcomed quite well in some countries, although the general picture is still far from positive.

	1992 Value	1992 %	1993 %
Multiuser systems	19	- 5.6	- 3.9
Personal computers	18	- 7.2	2.8
Workstations	2	10.9	16.9
PC printers	5	7.0	6.2
Office equipment	13	2.5	2.2
Data Communication hardware	3	7.2	3.9
Total hardware	60	- 2.3	1.5
Software	19	11.0	9.2
Services	34	8.8	7.4
HW maintenance and support	14	3.7	1.9
Total	128	3.0	4.3

Source: EITO/IDC

Table II
Western European IT Market Growth by Product Segment. Billion ECUs

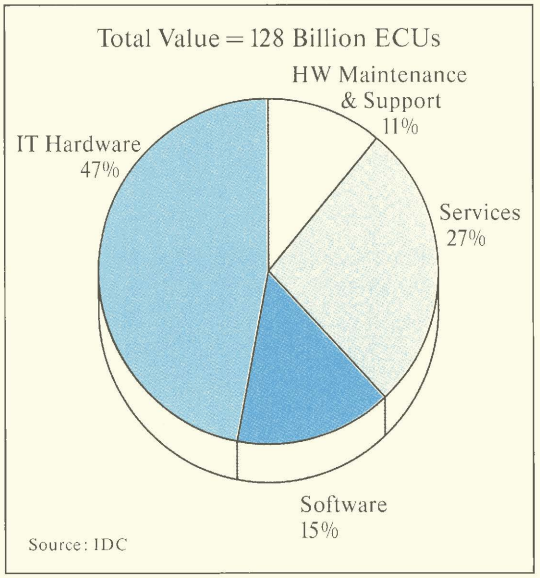


Figure 10
Western European IT Market by Product 1992

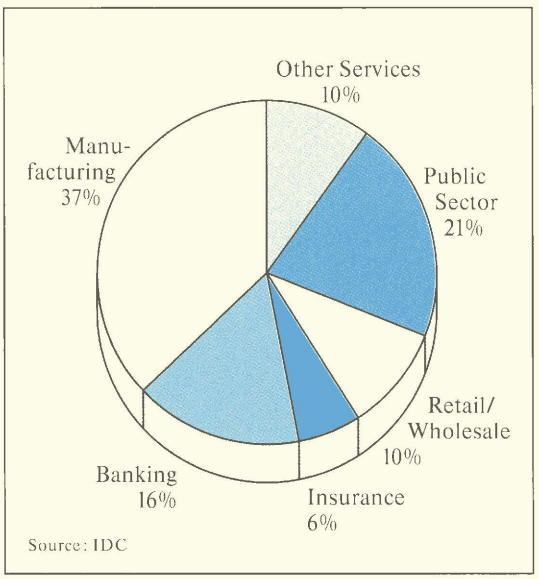


Figure 11
Western European IT Market by Vertical Market 1992

The situation is potentially darker for *medium-sized systems,* whose negative growth rate doubled in 1992. These systems find themselves squeezed between mainframes and inexpensive small open systems. At the same time, because they are frequently mission critical for the companies which use them, there is an understandable resistance against their replacement – a trend which is particularly acute among the medium-small sized enterprises which tend to be predominant in Europe.

Small-scale systems are beginning to feel the squeeze, but their situation is reasonably stable and the demand for Unix-based systems is still strong.

The *personal computer* segment is a case in itself because, although the current price war has led to negative growth rates in terms of value (– 7% in 1992), sales volumes have continued to increase.

As far as *workstations* are concerned, the rapid spread of RISC-based architectures and standard operating systems have eroded prices. Market value is still growing at a two-figure rate, but far more slowly than before. This is not a commodity market: price is not yet a critical factor, and perceived value and ease of use of the configurated system are far more important than raw hardware performance.

In response to changing needs in document creation, the *office systems* business is restructuring its supply mix. Decreases in the business of mature technologies (such as typewriters) are being compensated for by the development of innovative products (colour copiers, document management systems, etc.), and by the prolonged life-cycle of traditional products as a consequence of public regulations (cash registers in Italy).

Despite their more sustained performance, *software products and professional services* have grown significantly less than in previous years.

Expenditure by vertical markets is shown in *Figure 11.*

2.4. The Market in a Transition Phase: Drivers of Transformation

The current restructuring of the traditional IT industry will lead to the emergence of a new equilibrium and new purchasing patterns on the part of the average European IT user as a result of the combined effects of:

- technology;
- the recession;
- price wars;
- the development of services;
- third parties;
- user challenges.

Technology

There is a move away from centralised systems and towards hierarchical environments and distributed processing. Traditional mainframes are becoming super servers, and both organisations and Information Systems (IS) are networking. Downsizing (the move towards new applications on configurations of microcomputers and LANs to take advantage of cost reductions and supplied capacity) is well advanced.

The recession

The selective impact of the recession on the propensity to invest in capital assets has had different effects on the various target-markets, slowing down or postponing purchasing decisions mainly in relation to high-end multiuser systems.

Price wars

The effects of price wars on products based on standard core technologies are well understood. In these segments, players are reduced to the role of "price-takers" as it becomes increasingly difficult for them to set premium prices (and margins) through the differentiation of almost commodity-type offerings.

In the PC segment, price competition has lowered price levels so much that most users are no longer prepared to pay the premiums for a known brand of product that they would have paid up until two years ago. However, there are emerging signs of a reduction in the pressure on prices.

The development of services

Just as the European IT market has shifted towards focussing more on services and solutions, so the European IT industry is moving towards services based on consulting and systems integration. Overall, this means relative growth in the services market and a relative contraction in the hardware market.

Third parties

The development of services is coupled with the emergence of increasingly specific demand patterns which, although varying by vertical market, application, region and size of operations, have strengthened the position of third party players who provide different types of solutions for different sizes of users. These may be:

- software houses and top consultancy companies addressing large account Information System planning and integration needs, either in competition or in partnership with the direct sales force of traditional system suppliers;
- value added resellers and integrators working for medium-sized accounts with specific niche applications or specific vertical markets where, despite increasing price-competition, they can still successfully compete by leveraging on the users' historical perception of their good track record in providing solutions and services;

- dealers and platform resellers operating at the level of small accounts, but also addressing desktop users within large organisations by means of price-competitive offerings, and competing with the leading traditional PC channels via the use of new distribution techniques (such as telemarketing, catalogues or franchising).

Depending on their core business, these players may leverage on either margins or volume and can benefit from the generally greater flexibility of their organisations. In comparison with the top systems players, they are commonly characterised by:

- greater dependence on bundled-in core technology;
- greater dependence on vocational target markets and installed bases;
- greater dependence on the quality and skills of in-house programmers and consultants;
- greater financial exposure.

On the one hand, this positioning allows the strongest third parties to gain market share at the expense of traditional systems suppliers; on the other, weaker third parties have to seek distribution agreements with leading market players.

User challenges

User challenges relate to the lack of real integration in ICT usage. Despite enormous investments, user companies have no real central control over the individual elements making up their network or its related costs. Although legitimate professional requirements have been met, IT applications are installed and used within the overall topology of an organisation's Information System, as if they were still separate islands in a single archipelago.

This has led to a new perception of IT investment on the part of company managements. In the past, IT purchases led to a marked improvement in efficiency and IT was financed as a top priority investment. Now, the existence of a number of separate IT-intensive islands makes it difficult for the users to turn this long-dated investment into a strategic asset enabling an effective (and no longer merely efficient) information flow throughout the organisation.

The new challenge for many IT departments is that of restoring management confidence in their IT assets within the context of new organisational requirements and a new perception of IT, which is now being increasingly considered more as a profit/competitive edge generator than a simple cost centre.

3. Evolving User Needs

3.1. IT Challenges of European Users

A survey of a sample of 3,600 users in France, Germany and the UK carried out in Autumn 1991 revealed that the IT industry has to satisfy three major user requirements:

- technological updating, because this allows user companies to be more efficient;
- the integration of central and end-user resources, which requires a shift to an integrated vision of company information infrastructures (that is, a push towards greater effectiveness);
- cost control.

The order of priority varied according to the different types of response offered by the different operating environments. The need for integration was considered more important in traditionally strong proprietary mainframe environments, in environments where the weight of networks is high and in open UNIX environments, than among small-medium scale users with proprietary minicomputers running their mission-critical applications. A greater propensity to migrate was shown by almost all non-IBM and non-UNIX users.

3.2. Towards A New Computing Approach

Important changes are underway in computing. This is prompting a move from the old world of hierarchical architectures hanging on a single mainframe, to a new age of interoperability and cooperative processing across heterogeneous systems and networks.

However, technological evolution cannot be considered in isolation, as if it were an independent variable. It needs to be seen in terms of a reaction or response to the requirements of new user-company structures and new types of management responsibility.

Particularly in these years of mergers and acquisitions, it is highly probable that one company buys another which may not integrate at all with its existing computer/information requirement; and this requires an ability to manage underlying organisational heterogeneity from the point of view of Management Information System (MIS) management.

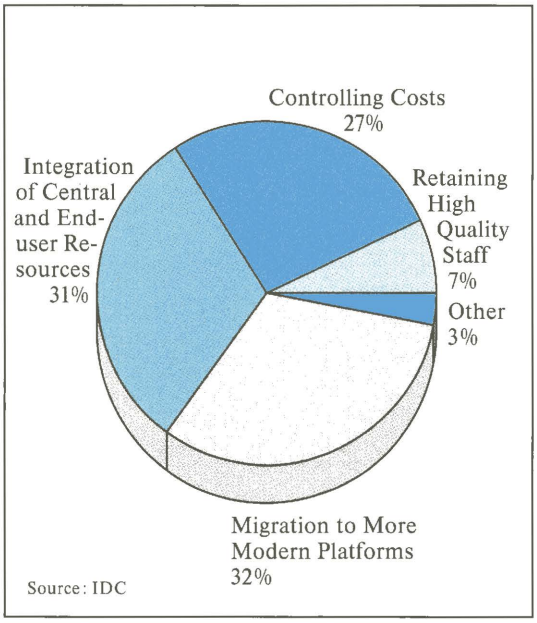


Figure 12
Key Information Systems Users Challenges for 1992 in Europe (Germany, France and the UK)

Management responsibilities are changing. In the past, it was usual to consider business activities in terms of traditional functional divisions (sales, marketing and finance); the new approach is based on an overall vision of processes which cut across these traditional divisions and generally involve selected elements from each of them. To be effective and reactive, these processes have to rely upon information and decision-making tools that come from a heterogeneous independent environment.

Quite clearly, information management must contribute towards an organisation's need to unite all of these individual elements into a complete whole and to ensure prompt and effective communication between all of its parts.

3.3. A Basically Integrated Environment

This is a question which goes beyond the integration of information systems and involves integration at all levels (organisation, applications and finance). This kind of integration cannot be guaranteed by the scarce resources that a company has available internally. The move towards interoperability and integration means making decisions on how to go from COBOL coding and proven, mission-critical but difficult to re-engineer applications, to open system platforms, open interfaces and portable distributed applications. It is this challenge which requires new expertise and resources probably external to the company.

Furthermore, the role of MIS management can no longer be considered as simply technologically oriented; it needs to be seen as an essential element of integration – and this is true for any kind of organisation, however developed the MIS function may be.

4. The Response of the IT Industry

4.1. Restructuring and the Search for New Business Models

How will the IT industry respond to the challenge of IT users, who want vendors to supply systems, solutions and services which effectively meet their business requirements for integration at all levels? The response of the IT industry reflects two different types of process.

4.2. Polarisation and New Integration

Polarisation

Suppliers are finding it increasingly difficult (both competitively and financially) to meet user needs by maintaining technology manufacturing and solution provision under the roof of the same vertically integrated structure.

The adoption of new business models has led to a trend towards specialisation in the IT industry: technology manufacturers and professional services groups have already developed towards two poles, respectively upstream and downstream of the value chain; traditional IT systems suppliers are in the process of repositioning themselves somewhere in the middle but with a clearer tendency towards one or other of these poles.

Upstream, there are the companies who specialise in building the best technologies they can; downstream, the companies who concentrate on "providing solutions", endorsing the technology and supplying services and support useful for the customer.

New Integration

This process is coupled to the emergence of other new forces which go in the opposite direction, towards the integration of new func-

tions/technologies and capabilities that will be bundled into innovative offerings and thus create the conditions for the development of the new markets referred to in the previous chapter. These offerings are likely to include consumer and mobile computing, and the linking of computers and televisions, all of which will probably have a considerable effect on the overall structure of the industry.

From the point of view of the competitive environment, the scene is further changing as these alliances give rise to new "virtual companies" (created as a consequence of agreements leading to vertical integration) which are beginning to shape new competitive rules and behaviour.

4.3. Positioning of IT Players

In order to understand what these processes mean for the positioning of European IT players versus suppliers from other regions, it is useful to consider their place in the IT value chain on the basis of their current marketing mix.

Three major groups can be identified:

I. companies upstream, specialised in the manufacture of core technologies (mainly US and Japanese companies);

II. companies downstream, specialised in the provision of solutions and services (mainly global US and European services groups);

III. companies in the middle (those US and European players who are often referred to as traditional vertically-integrated computer system companies).

It is within this last group of companies that most of the financial and performance problems tend to emerge. Forced to reposition themselves, they have generally adopted one of three main strategies.

Some are entrenched in too many markets to be able to retreat to one pole or the other. They have reached a size which allows them to compete on both fronts, and have reshaped their organisations accordingly.

Some of the US traditional hardware manufacturers have decided to go upstream, having been successful in introducing new technologies to the market and supplemented their direct sales activities by aggressively entering the OEM business. They are increasingly willing to offer their best technology to the market as a whole rather than concentrate on their own product and service channels.

Most of the European IT players have decided to move downstream, gradually leaving the business of hardware and systems software production and to begin endorsing the basic technologies of other companies. This allows them to concentrate their in-house resources on providing solutions and systems integration capabilities.

The key point here is that not everybody can do everything, and they need to confront the challenges of new markets by forming new alliances and families.

4.4. Integration and New Markets

Analyses of the IT industry and its markets have traditionally considered user demand for IT designed to carry out efficiently and effectively those business and public service functions which were the first objects of automation. As user needs become more complex, this demand is evolving towards new technological and service requirements which will lead to radical structural changes (a shift from the purchase of hardware power towards business-focused IT utility) but to no major increase in absolute size.

Traditional IT demand has reached a threshold of maturity which, thanks to the pace of technological development on the supply side and a growing awareness of how to use IT on the demand side, has generated a favourable environment for the introduction of new kinds of markets, now in their infant stage.

The technological empowerment of traditional business users has gradually led to the greater possibility of applying IT to needs which are currently satisfied through other technologies or services, and to the generation of new kinds of needs. These new development markets/opportunities correspond to the nature of the information processing needs to be targetted.

During the early stages of the development of the IT market, it made sense from an industrial viewpoint for vendors to bundle, and for users to purchase hardware, software and services together. As the industry matures, both users and vendors are increasingly tending to consider them separately. Consequently, competition in each area is becoming more important than the integration of the three, and product/service lifecycles go through different stages of development or managed decline.

Analysis of the different stages of bundling/unbundling currently emerging on the IT marketplace, as well as of the demand segments currently being addressed, suggests an interesting correspondence between the market potential of the new supply mix and traditional and new IT needs.

Three major areas can be identified:

- business focused solutions;
- service infrastructures;
- personal electronics use.

Business focused solutions

The increasingly business-oriented focus of MIS functions is reflected in the evolving patterns of demand towards greater accountability in relation to IT investments: improvements in the effectiveness of the information system and the possibility of using the information system itself as a tool for acquiring a competitive edge. The implications in terms of technology and service requirements have already been described.

This trend leads IT companies to address their traditional target markets by concentrating on niche or vertical market applications and solutions. This is mainly done by developing the company's business model towards greater specialisation throughout the value chain, especially in the supply of "middleware" applications and business-oriented services.

An outstanding example in this sense is likely to be provided by the manufacturing industry, where computer applications are seeping into the market more rapidly than was at first thought. It is expected that the growth of Europe's CAD/CAM/CAE market will be 10 times faster than that of the IT market in general. European industry has invested extensively in modernisation in order to equip itself for the increased competition and additional opportunities of a unified market, which will lead to the much faster spread of computer technologies throughout the manufacturing industry (a process which only really began in the second half of the 1980s).

Service infrastructures

The trend towards the integration of the European market, and the increasingly complex task of managing public services with scarce resources, are making it increasingly urgent to integrate telecommunications infrastructures and improve the quality per cost of public services.

The *business community* is looking for technological support to develop more efficient means of communication within international organisations (teleconferences, electronic data mail, videophone communication, tele-assistance), and new ways of managing their business (telemarketing, teleservices).

Public service authorities require greater marginal contributions from more tightly-controlled public expenditure, in terms of the effectiveness of the assistance provided by their services (the automation of the delivery of certificates, centralised databases of public health records, public transport route timing displays, "citizen cards"), in terms of the quality of life in general (computerised information and control over air-pollution levels in large towns), and in terms of the control of fiscal income and public expenditure.

The *social community* in general is looking to satisfy already existing needs in a more efficient way (teleshopping, telebanking), and to satisfy needs that may emerge from the spread of these technologies among private home-users (information security, access to new public databases).

For public administrations, this means that a number of important challenges need to be met. The realisation of European unity is inconceivable without modern structures of administration. Existing cooperation among public authorities within the EC (in areas such as tax legislation, EC market regulations and the regulation of international trade relations) points to the growing internationalisation of economic relationships. The increasingly complex tasks facing the public administrations of today demand the application of the most modern information technologies in order to speed up the growth of the European market.

For IT companies, the telecommunications infrastructure represents a considerable opportunity because it would lead to the removal of the current technological constraints (the lack of homogeneity in the public network, different levels in the implementation of new technologies - such as ISDN - in different countries, the low level of digitalisation of the phone network) that delay the improved integration of the IT applications of the business community. It would also improve the status of more innovative applications offering better services to the business community and, within the context of public services, to the social community as a whole. In this area, players are tending towards greater specialisation, either in the development of technology or in the provision of high value added services.

But there are other areas of major interest where the majority of the work has yet to be done; here, it seems to be more a case of addressing potential IT use with "bundled" solutions, suggesting an interesting parallel with the early development of the IT industry as a whole.

Personal electronics use

The individual user of information technology has acquired a more sophisticated awareness of the potential of traditional office technology for delivering new services. On the one hand, these are wanted to facilitate business tasks and functions (e. g. enabling access to a company's network via a personal digital system connected from anywhere in the public network); on the other, to provide innovative solutions to mass consumer domestic/entertainment needs.

With the growing development of these markets, a gradual unbundling of the offer is likely: hardware will gain some independence from the information content, which in turn will become more independent from the communication medium.

These products may be addressed either to personal single-users or private mass-consumers.

Personal single-users are interested in the technology for consumer or business needs, but definitely in connection with public or private telecommunication networks (TV, data or phone) and as intensively as the available business/home technology infrastructure permits. In this sense, it is not necessarily so important for a player to be the first-comer or the most innovative; it is possibly more important to be able to live long term in one sector with the most appropriate business model for that sector's stage of development. In the end, high market growth will benefit hardware, software and services alike, even if the initial successes will come through bundling all three.

Mass-consumers are the targets of video services, the integration of computers with TVs, mobile services, video-data services and voice services such as cellular phones. Entertainment services will be delivered through the bundling of a particular type of hardware derived from personal computer technology with a particular software as the means of communication.

Throughout this process, it is also reasonable to foresee that the phone industry, as well as the TV and (probably) the publishing business, will be virtually re-invented, thus creating enormous further opportunities for suppliers. This is the largest potential market of all: today consumers spend more than 7,000 billion ECUs worldwide on goods which are (at least potentially) related to IT.

There is no doubt that many of the current trends towards the adoption of IT are encouraged by plummetting PC hardware prices. The possibility that mobile PCs may soon be able to enable complete new functions is another driver.

The sales success of notebook PCs is just the beginning of this "mobile revolution". Mobile, ubiquitous pen computing will be the next step and a lot of computer companies are recognising the importance of pen technologies in their short and long-term plans.

Between 1993 and 1996, worldwide pen hardware revenues will increase six-fold, and they are likely to be far larger after a further ten years. What is perhaps even more heartening for hardware manufacturers, the vast majority of mobile PC users see them as complements rather than replacements for desktops. In Europe, despite primary inhibitors such as localisation and expense, the very size and sophistication of the market makes it extremely attractive for pen computer manufacturers.

Demand for mobile computing software implies a significant change of focus for mainstream PC manufacturers, whose R&D resources are increasingly focussed on miniaturisation as the two markets of smaller PC notebooks and scientific calculators begin to converge, and handheld computing begins to develop.

The need to combine breakthrough hardware and breakthrough software creates a further need for integrated suppliers. The most successful suppliers will tightly couple hardware and software, and some pen software suppliers will bundle vertical applications with their products.

5. Future Perspectives for the European IT Market and Industry

As has been seen, although the immediate future for the European market may not look so bright, its potential is still enormous. At the moment, it is going through a transition phase characterised by two main factors: the economic recession has led to a certain instability and discontinuity in the development of the industry, because it has reduced the propensity of users to invest in large-scale capital assets; secondly, increasing user demand for specific solutions is generating greater differentiation among the various segments of the IT market and a consequent price-competitiveness which is severely affecting the profitability of most hardware suppliers.

The first of these factors concerns the effect of external conditions on the IT industry; the second is strictly tied to the structural evolution of the IT sector itself. It is their convergence which is affecting the stability of the growth of the European IT market.

The industry now has to consider the various choices available to it in order to make the most of the opportunities which the market has to offer.

The spread of open system standards among European users has not only led to a crisis of profitability, but also to a crisis of identity among traditional vertically integrated IT vendors.

This crisis of identity has been caused by the speed with which user requirements have changed: technology alone is no longer sufficient because users are now looking for the expertise which will help them meet their business needs.

Furthermore, these vendors are simultaneously facing rapidly growing competition from system integrators, professional service providers and VARs (value added resellers) who are beginning to cover an increasing share of the market, and this has also had an impact on their strategies and organisational structures.

In order to recover and enhance their competitiveness, traditional system suppliers have generally responded in one of three ways:

1) They have diversified from hardware towards software and service activities in an attempt to shift a larger part of their revenues towards more profitable areas. In some cases, this has led to the development of strictly synergic business activities; in others, independent application solution or system integration companies have been founded with the aim of developing independent activities in their specific areas.

2) They have rationalised distribution channels by developing and implementing new policies towards third parties, and by optimising the management of indirect channels.

3) They have created alliances: agreements for the joint development and/or supply of products and services to meet specific market requirements; technological agreements designed to spread the load of R & D investments; and OEM (original equipment manufacturers) agreements. This last solution is of considerable interest because it expresses a fundamental change of approach: instead of reserving their best technologies for their own product and service channels, vendors are now prepared to offer them to the overall market.

The development of the partnership model is strictly related to the segmentation of the IT market, which requires suppliers to focus on special market niches in which they can provide qualified solutions in specific application areas and/or industrial sectors. Most of the players (and certainly all of the traditional European suppliers) are unable to cover the entire market, and are obliged to accept a policy of alliances in order to be able to focus their operations as much as possible on their core competence business.

In a market which is being driven by users who are increasingly concerned about obtaining value for money, and who are free to choose from a wide variety of alternative offerings, there is no longer any room for a competitive system in which everybody is against everybody else. The growth in user power has injected a greater awareness of the complementary nature of the business. The competitive environment is changing from one with a large number of full-range suppliers to one made up of a more limited number of relatively integrated families of companies, each one focussing on very specific market segments or niches.

The European market has a significant advantage over that of the US in that it is much less saturated. This means that Europe can enjoy a significantly higher growth rate over the next ten years before it reaches a level of saturation similar to that of the US.

This is an opportunity not to be missed by the European IT industry and European entrepreneurs.

Information Technology: The State of the Art and the Key Technological Factors of Evolution

The aim of this chapter is to point out the most important technological factors in Information and Communication Technology (ICT) which are of decisive importance for the market now and which will continue to be so in the near future.

1. Evolution in ICT: A Global View

The term ICT is becoming increasingly used to define a whole complex of technologies ranging from information systems to software engineering, consumer electronics, telecommunications and industrial automation. While it is recognised that each of these fields has its own internal dynamics, the increasing interaction between them makes it necessary to consider the mass of technologies, their products, and the manufacturing organisations which make them available to the consumer as belonging to one unified field. ICT includes every type of information a person is accustomed to managing, given that any piece of information can now be expressed by a sequence of bits which can be processed and encoded. This capability is often called the *"full digital approach"*, therefore, the information we refer to can include data, text, voice, sound, signals (for example, telemetry and process control), and both still (fax, photos, graphics, etc) and moving images (TV pictures, animation, video, etc).

Four strictly related and interacting basic technologies underlie the evolution of ICT:

- *microelectronic component technology;*
- *hardware computer technology;*
- *software technology;*
- *telecommunications technology.*

All of them cooperate and interoperate by means of appropriate *architectures*. Some architectures are specific for a particular technology; others are comprehensive. The evolution of technical architectures plays a key role in ICT, and both influences and is influenced by the four evolving technologies.

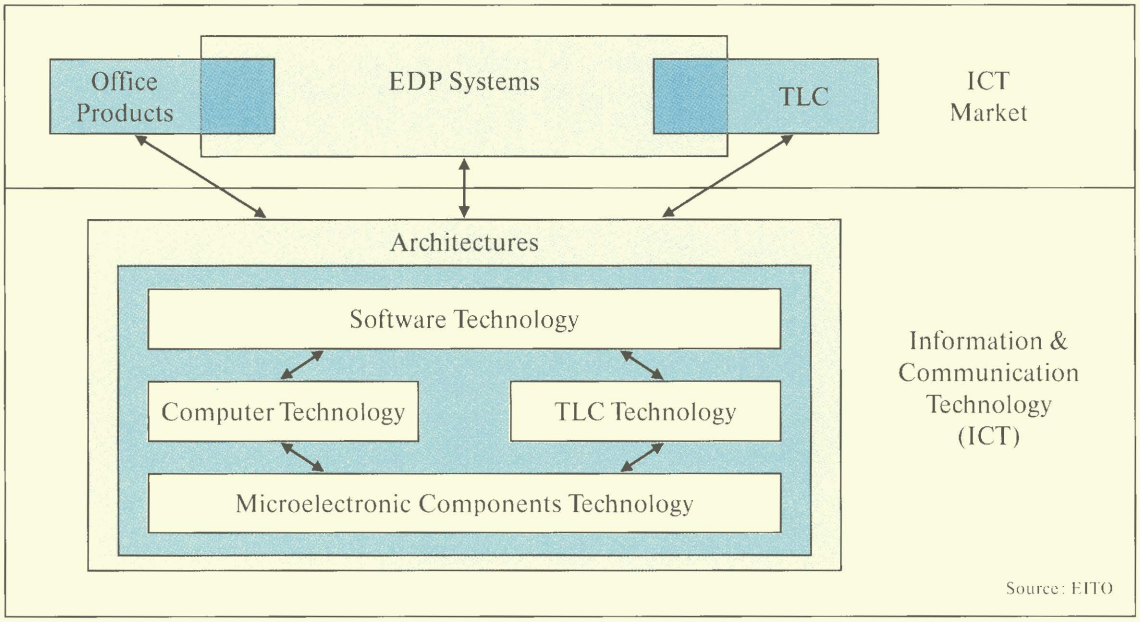
Viewed as a whole, ICT also influences and is profoundly influenced by a market which this EITO report has subdivided into:

- office products;
- EDP systems;
- telecommunications.

These relationships are shown in *Figure 1.*

The first part of this chapter describes the mega-trends affecting the basic technologies listed above. Subsequently, the main impacts - in terms of services, systems and products - are considered for each of the three ICT market segments plus the cross-cutting semiconductor segment. Given the limited space available, only the most interesting items will be investigated in some detail in the later sections. It is important to underline that there is no longer any specific

Figure 1
Relationship between Office Products, EDP Systems, and Telecommunications



border between each market segment: office products are increasingly becoming data processing products; and systems, data-processing and telecommunications are becoming increasingly interconnected.

Microelectronic component technology

Microelectronics constitutes the most strategic key technology for the whole of the ICT sector; a constant stream of innovations are being announced, especially in the fields of optical and magnetic memories and microprocessors. The mega-trends for this sector are:

- very large-scale integration (see *Figure 2)*;
- the improvement of microprocessor capabilities;
- a constant increase in the passage from electronic circuitry to LSI/VLSI, and from basic software to firmware;
- constant decreases in component prices.

Hardware computer technology

By the term "computer technology", we mean all data processing, storage, retrieval and presentation hardware technology. Computer technology therefore includes all I/O devices, in particular those mainly interfacing with the end-user (keyboards, video monitors, printers). The mega-trends for this sector are:

- a constant improvement in "intelligence" (see *Figure 3)*;
- increasing systems reliability and availability;
- technological downsizing of systems, while maintaining the same capability;
- a reduction in the system life-cycle which implies window reduction for competitive advantages;
- the key role of microcomputers and workstations.

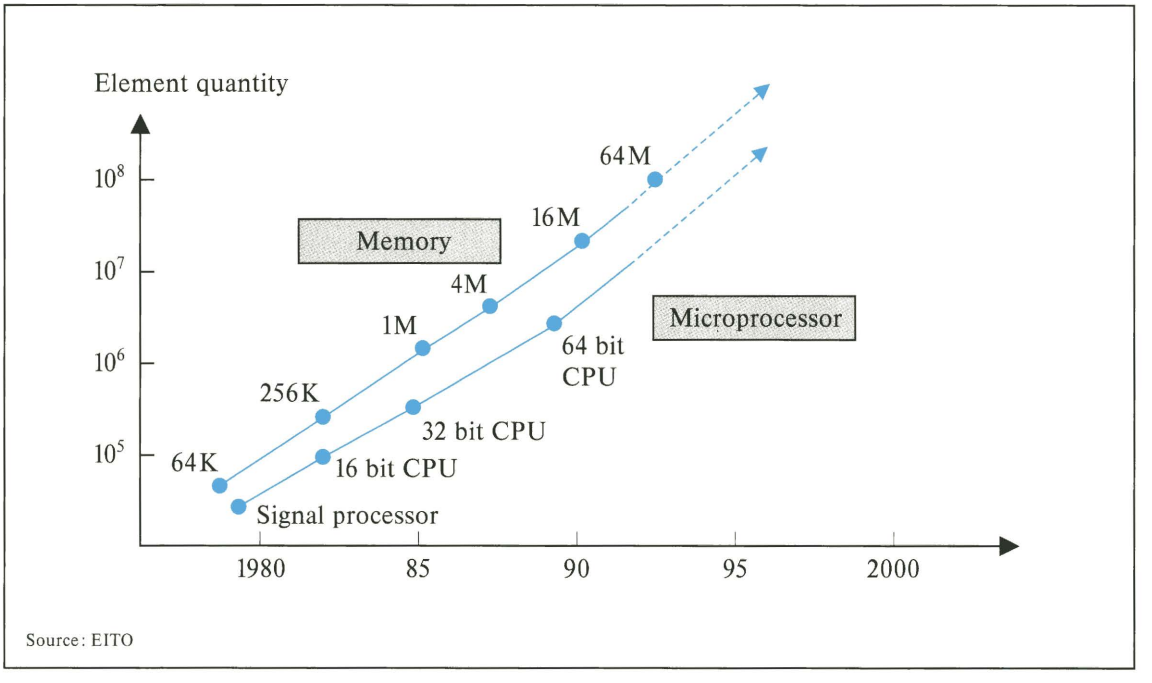


Figure 2
Larger Scale Integration

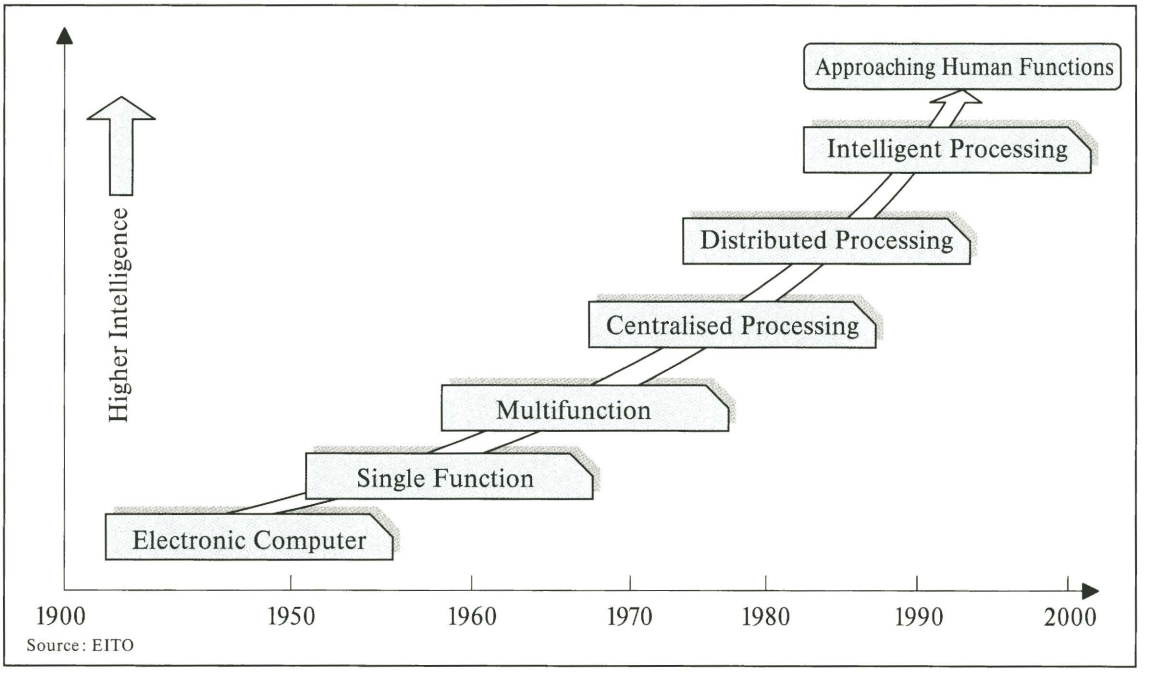
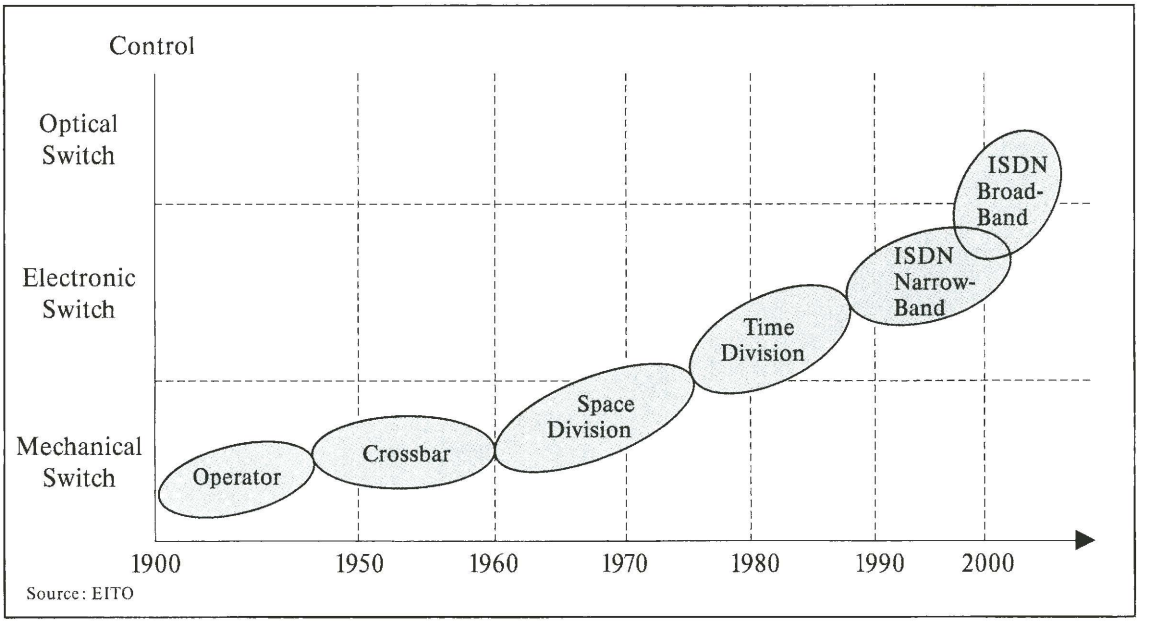


Figure 3
Higher Intelligence in Computers

Figure 4
Evolution of Switching Technology



Telecommunications technology

Telecommunications technology allows information *transfer* and *exchange*. The mega-trends for this sector are:

- the widespread adoption of information systems;
- the full digital approach, leading to ISDN (see *Figure 4)*;
- transmission integration and the use of diversified combinations of transmission media and channels;
- the integration of services;
- mobile personal communication.

Software technology

Software technology initiated as a programming technique for driving hardware. The widespread increase in system complexity, and the interfunctionality of all of the basic technologies of the ICT world, means that software is playing a key role as the operational "adhesive" of the whole ICT system and is bound to continue to play that role. The mega-trends for this sector are:

- an increasing level of intelligence of the system itself (artificial intelligence, expert systems, etc.);
- the improvement of the human interface, particularly in terms of "banalisation" and "user-friendliness";
- the improvement of the quality and productivity of software engineering (see *Figure 5)*;
- the introduction of new concepts and logics, such as "object" and "fuzzy" logic;
- the introduction of new and often integrated application services and functions that permit an increase in the level of end-user productivity and job quality.

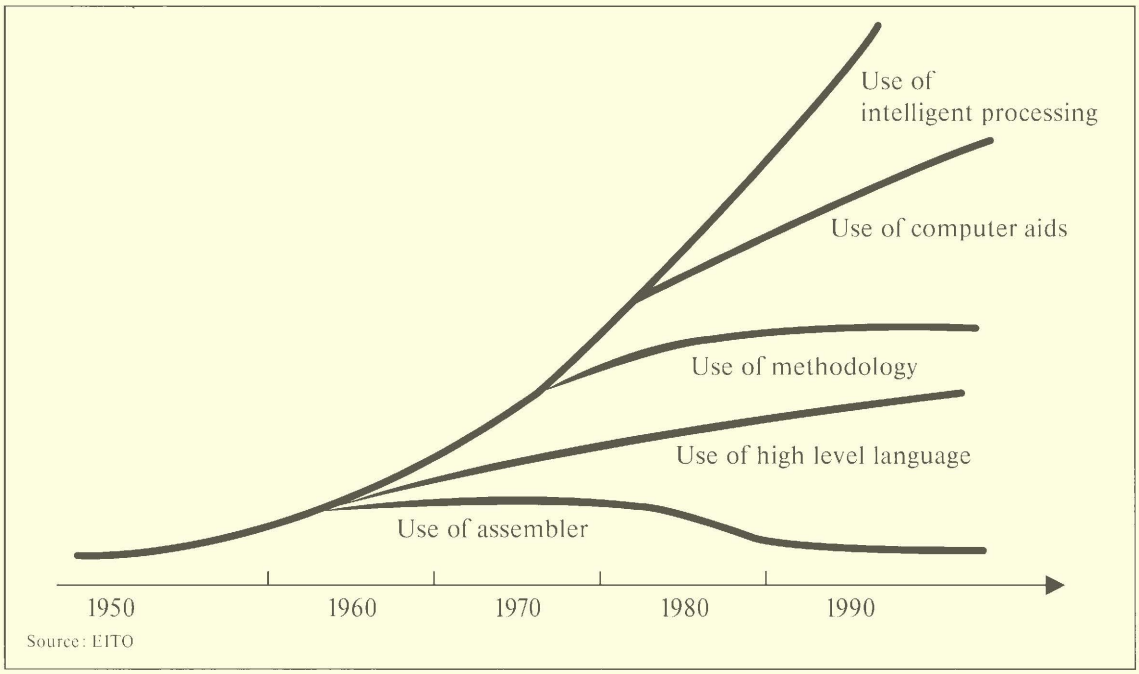


Figure 5
Development of Software Production Method

Architectures

All of the increasingly complex technologies for information systems require the definition of a specific "personalised" *Comprehensive Enterprise Architecture* (CEA) which, in turn, includes some of the possible architectures used for the specific technologies adopted.

The main trend is the transition from hierarchical centralised architectures separated per each type of information towards heterogeneous, distributed, integrated architectures. This evolution implies a greater degree of complexity in design, development, installation, management and maintenance.

For the new *open* architectures (discussed in more detail in Section 4.2.), two main requirements have to be satisfied: *interoperability* among different systems and the *portability* of the application and environment software among different platforms.

Interoperability and communication integration generate a higher role for networking: both for local area networks (LANs) and for wide-area networks (WANs).

Interoperability requires suitable *network management*, part of a more general and better integrated *systems management*.

Figure 6 gives an idea of the possible complexity of a modern information system requiring integrated system management.

The trends mentioned for ICT architectures are valid both for EDP systems and for TLC.

Two common and general trends

Two important factors common to all previous technologies deserve special mention:

- *standardisation;*
- national and/or proprietary *control of technology.*

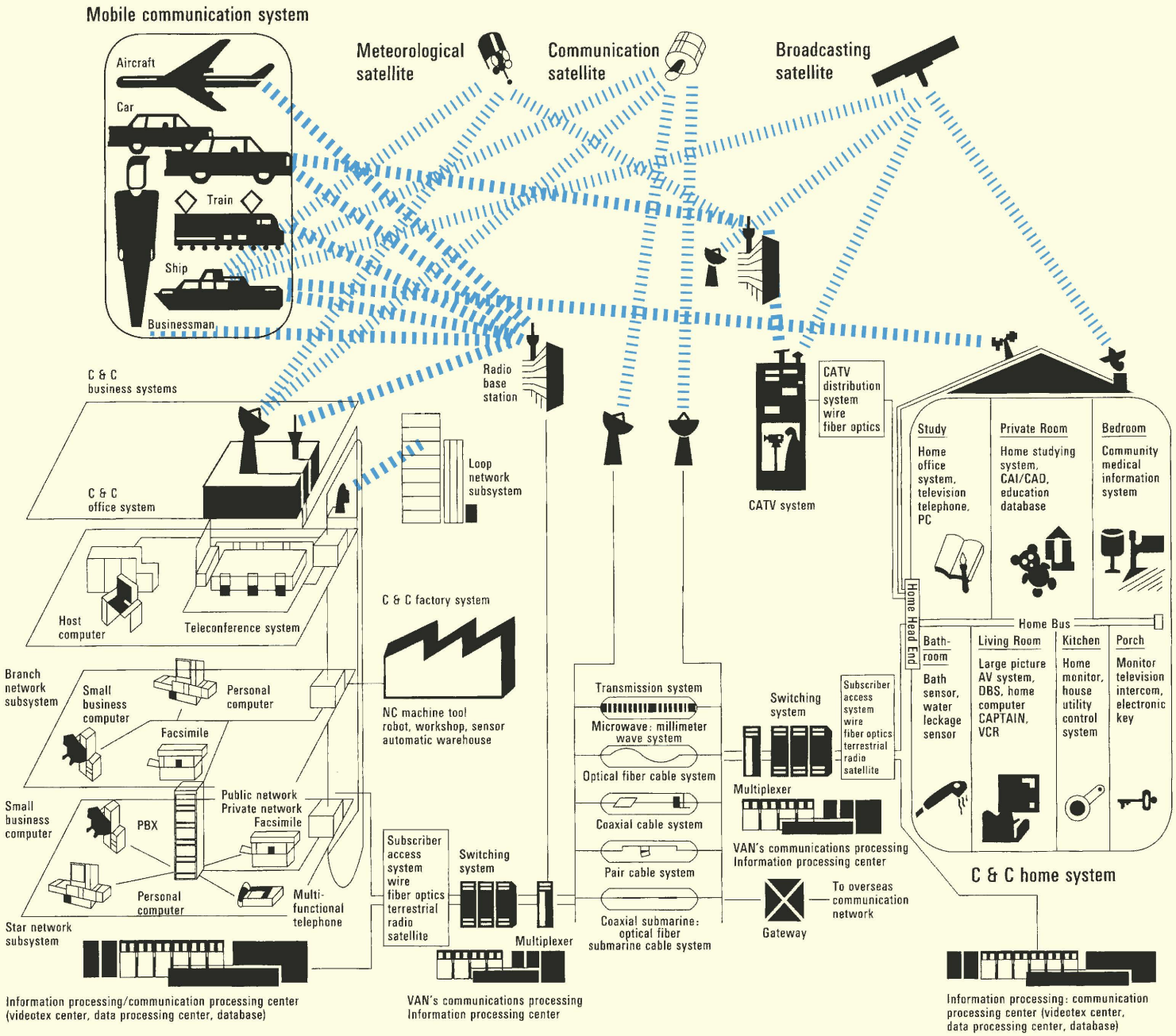


Figure 6
Establishment of Information Network

Source: AICA/SMAU

In the ICT world, the implications of standardisation are decisive and becoming more important day by day.

International standardisation activities are now coordinated by ISO, IEC and CCITT (see Part One, Information Technology Standardisation, for more details), and cover all aspects of ICT, particularly interfaces, protocols, services, reference models, implementation guidelines, hardware platforms, software environments, quality and security.

Proprietary control of some specific technologies (in particular for hardware) is today less severe than in the past, not only because the political context has changed, but also as a result of a number of cross-agreements involving nearly all of the ICT manufacturers: agreements relating to joint research projects, joint development, OEM, etc. These mean the availability of more than one source for a specific technological item (semiconductors for instance), more competition among providers and, consequently, price reductions and a reduced "monopolistic logic".

2. Microelectronic Components

Trends in the evolution of processors, memories, disks, and so on, are affected by three factors:

- the increasing power and speed of CPUs;
- increasing levels of integration;
- increasing memory size.

Hence, more functions are directly incorporated onto chips by means of LSI technology and it is now possible to use software to perform some operations that were previously performed by hardware.

Twenty years ago, Gordon Moore, the founder of Intel, formulated a law which still holds true today: "The number of transistors on a single silicon chip doubles every two years." With the introduction of submicrometric techniques, it is now possible to compact up to two million transistors on a chip. By the end of the nineties, the experts forecast that 100 million transistors will be integrated.

In this perspective, the most important news concerns:

- the diffusion of 32-bit processors and the advent of 64-bit processors;
- the enhancement of RISC technology;
- the introduction of memory chips with several Mbits of capacity;
- the introduction of solid-state memories and single-chip computers, which enable the realisation of hand-held computers.

2.1. RISC and CISC

At the moment, the attention of operators is focused on the CISC-RISC competition.

Until now, CISC (Complete Instruction Set Computer) has been the most diffused technology for PCs. Each CISC processor has a set of power machine instructions allowing complex operations, but the very large-scale integration that these chips require makes the project phase and production expensive.

RISC (Reduced Instruction Set Computer) technology comes from a new idea: "to execute a reduced set of fundamental instructions very quickly and with the highest degree of optimisation". Of course, if the instructions are simpler, the CPU needs to execute more instructions than with a CISC processor in order to obtain the same result; but the use of very fast input-output systems from and to memory, high speed buses and ad hoc compilers makes RISC computers better performers than CISC computers. RISC CPUs are used in top-end personal computers and workstations, but the new series are also used in medium and large-size systems with parallel architectures. In this context, there is an increasing tendency to associate RISC environments with the Unix operating system.

2.2. New Memory Technologies

Until the introduction of solid-state memory cards, any reduction in the size and weight of personal computers was limited by the size, weight and power needs of the mass-storage memory device.

Solid-state memory cards look like credit cards. They are light and can store several megabytes of data. They do not have moving components, so the power they require is much less than floppy or hard disk drives; and they are more resistant to shocks. The standard for memory cards has been defined by two groups: JEIDA (Japanese Electronic Industry Development Association, founded in 1985) and PCMCIA (Personal Computer Memory Card International Association, founded in 1989). The members of PCMCIA are the most important semiconductor companies.

PCMCIA and JEIDA have defined a common-standard, 68-pin architecture which has been adopted by all companies. This means that cards can be interchanged like diskettes (furthermore, it is possible to use memory-card slots for other devices, such as modems or network adapters).

Memory cards are a "packaging technique" and, as such, they can use any type of semiconductor memory: RAM, ROM, EPROM or EEPROM. However, the most important is a new technology called "flash memory". Flash memories replace EEPROMs: they are read/write non-volatile memories. During a read/access process, flash memories are much faster than disks, their time being comparable to that of a DRAM. On the other hand, their write time is still as slow as that of magnetic media. It is possible to write a single byte but, because the erase process is sector-oriented, nothing less than a sector can be erased.

Flash cards are already produced with different sized memories (from 1 to 20 Mbytes), but the large companies are already working towards 40 Mbytes of storage.

3. Office Products

The office products area includes all of the systems listed in Part Three, Statistical Outlook, 10. Definitions. It should be remembered that not all of the office products on the market come into the ICT field (for example, franking machines, labelling machines, letter-opening and sealing machines, folding machines, enveloping machines, and folding, cutting and binding machines).

As they evolve, ICT-based products offer new functions which are gradually leading them into the information-system area as specialised computers. POS terminals, typewriters, pocket calculators, document filing systems, and so on, will all be considered under the heading of EDP systems.

The most significant innovations for the remaining IT office products concern copying machines, in particular the introduction of digitisation and colour. Copying machines have also been influenced by the innovations in printer technology described in Section 4.1.

There are also important innovations in the technology of conventional copiers, whose performances improve every year. Important news concerns "both-side copying" (where a sheet of paper is printed on both sides in only one step) and remote diagnosis for detecting technical faults and prescribing repair schedules.

Digital copiers are simultaneously both scanners and printers. Some models can be used to file and, using cut-and-paste techniques, even edit documents.

High quality matrices, controlled regulation of ink distribution and the use of plain xerographic paper, allow photographs and complicated characters to be reproduced with great clarity. Different machines can also be fitted with automatic original feeders, copy programmers, and programmed reduction, enlargement or variable sizes by means of a zoom mechanism.

The more advanced models have editing functions that can be used to highlight or erase parts of the text, insert photographs and do multicolour printing without changing the printing roll. Such copiers have reached very good performance levels.

The most interesting options include the possibility of coupling these machines with on and off-line binding units; the availability of extra, easily interchangeable colour printing rolls; and, for certain models, a PC interface which allows the direct printing of PC-created documents and the transfer of documents from digital duplicator to PC by means of a scanner. The top-end market leader has recently presented extremely sophisticated duplication systems that integrate document-processing technologies.

Colour copiers are classified into four groups, depending on the technology used in reproduction: electrographic, cycolour, heat transfer or photographic.

Electrographic copiers are the most widely used. The image to reproduce may be read either in analog or digital mode and then composed on a conventional copier cylinder in four steps, one colour at a time: cyan, magenta, yellow and black.

Cycolour copiers use analog systems to capture images on special colour-sensitive film. The film image is then chemically transferred to paper.

Heat-transfer copiers use an impact printing system with red, blue and green ribbons.

4. EDP Systems

The generic term, EDP (Electronic Data Processing) systems, is very often used as a synonym for Information Technology and normally includes office products but not TLC systems.

Up to some years ago, EDP was strictly related to data-processing (mainly for the automation of accounting and administrative procedures).

The evolution of computer and – the main pillar of EDP – software technology, together with the growing needs and demands of the end-user, is leading towards a more intelligent and better integrated use of information (for example, the use of decision support and decision-making systems).

4.1. Computer Technology and Hardware Products

Every day, there are announcements of improvements in the different segments of computer technology: mainframes and supercomputers, mini-workstations and microcomputers, hand-held computers and their peripherals. These continuous improvements are generated by the evolution of both components and peripherals, particularly monitors, storage devices and printers.

After a general overview of technological trends in products and systems, "parallel processing" and "multimedia" systems will be analysed more thoroughly.

Very large and large-scale systems

The mainframe still remains the "central" host in most corporate information systems. The most important improvements in large-scale systems are:

- fault-tolerance and multiprocessor architectures;

- the use of new and more powerful chips providing increasing RAM;
- memory management based on a "cache" hierarchy using memory chips of different speeds and powers;
- the use of disk array solutions for mass storage;
- a new channel logic based on fibres and new interfaces, such as ANSI HIPPI (High Performance Parallel Interface) or IBM ESCON (Enterprise Systems Connection Architecture);
- enhanced operating systems providing some "standard" interfaces (such as Posix) and protocol piles (such as TCP/IP and ISO/OSI) for software portability and interoperability;
- Unix support.

Medium-scale systems

In large and very large information systems, the medium-scale computer normally plays the role of "departmental" host and/or that of a machine dedicated to a specific function, such as office automation, on-line transaction processing (OLTP) or the support of relational data bases. For medium-sized and small companies, the medium-scale computer acts as the only "host" for the whole company, and often also operates as the LAN server.

The medium-scale area is dominated by the Unix environment, although some proprietary operating systems are still widely used.

The main lines of evolution in medium-scale systems are practically the same as those in large-scale systems.

LAN servers and superservers

A growing niche is constituted by *LAN servers* and *superservers,* which borrow their architectures and logic from fault-tolerant multiprocessing systems.

LAN servers have four primary functions: to provide file, database, print and communication services.

Originally, server functions were performed by a minicomputer or, in PC LANs, by a dedicated common personal computer: as LANs grew and began to require increased power, the manufacturers designed a new class of system capable of rapidly processing large amounts of data with a high level of availability and reliability. In fact, from a technological point of view, these superservers combine mainframe and mini logic with PC design and processing.

PCs and workstations

In the *PC* and *workstation* sectors, the following developments are clearly apparent:

- the substitution of conventional terminals with PCs and intelligent workstations;
- the erosion of the boundary between PCs and workstations, with the upgrading of the personal computer;
- the arrival on the scene of even smaller and lighter portable and hand-held systems;
- great improvements in user-friendliness and graphic user interfaces (GUI), and the introduction of speech synthesis and voice recognition;
- the use of solid-state memories.

As mentioned in Section 2., CISC is the processor technology for the PC, and the present *de facto* 32-bit standard (the 386) will evolve and probably maintain leadership with the 486, 586, 686 and so on.

RISC architectures dominate the high-level workstation range. As will be discussed in Section 4.3., different operating systems and graphic user interfaces will segment the sector according to the required functions.

Portable and hand-held computers

Lap-top, notebook, hand-held and pen-based computers constitute the most impressive frontier of ICT research for the end-user. Their implementation has involved significant improvements, at the limits of present technologies.

The primary characteristics of these products are their very limited size and weight: a lot of ground has been covered since the first "portable" on the market: a notebook now weighs less than one kilogram, and hand-held computers just a few ounces.

All of these products are strictly at the service of the individual ("personal media") but they can also be interconnected to other systems, such as company information systems and/or public networks and services.

Almost all of today's smallest computers are DOS-based, and the main software houses have released special versions of their DOS programmes to support palmtops. Almost all of them have a word processor, a spreadsheet, a database and some programmes for use when away from home, but the key factor for their success seems to be their compatibility and easy connectivity with larger desktop computers in the office or at home.

Input/output methods for small-size computers are limited by the size of the device. It is hard to type on tiny keyboards and, although useful on the desk, a mouse is a problem when travelling. Other input methods are more practical: *pens* and *touch screens*.

Pen computers are a revolution compared with conventional input systems. They require a sophisticated operating system with the ability to recognise handwriting and commands entered by touching the screen. Pen computing requires an application to be designed from scratch, but the major software companies have nevertheless announced their interest in this field.

This successful new segment has also improved the accessory market. We are seeing new mouses, portable printers, modems, hard disks, back-up devices and CD-ROM drives that do not require a computer slot, but can be directly connected to a standard parallel port.

Video display techniques

Colour display remains a problem for portable devices. Colour "costs" in terms of power supply, and the active matrix, which could also be used for notebooks, still requires a high outlay. Some manufacturers are therefore offering a "passive matrix", although the quality and resolution are less, and "portability" problems still remain.

An active matrix video integrates Thin Film Transistors (TFT), with each pixel being driven by three transistors. A VGA standard requires 921,600 diodes, and if only one of them crashes, the whole video is out. In a "passive matrix", each row and each column is driven by just one diode. The cost is lower, but so is the quality. Refresh is slower, and the use of a mouse is a problem.

Screens are normally liquid-crystal, particularly for portable computers: flat and light, they absorb hardly any electric power. LCD screens use their liquid-crystal capacity to reflect light according to their physical state, which can be determined by an electronic circuit. The mean response time of an LCD is rather slow in comparison with that of a cathode-ray tube.

Printer techniques

Together with a reduction in cost, graphic quality and colour are the main goals.

All of the current techniques can be considered as either "impact" or "non-impact" technologies.

Impact technologies include the matrix and daisy-wheel printers: these are now mature, and innovation is concentrated on optimising costs and improving their speed, availability and design quality.

Non-impact technologies include riprography, and ink-jet and thermal transfer.

With riprography, the image is created by means of different light sources: a laser, LED array, or lamps and liquid crystal shutter. Lasers are most used, and the main innovative trends are aimed at reducing the cost and size of the laser box, and improving the resolution of the image.

Ink-jet technology is not new, but it is only recently that the main problems of reliability have been solved.

Thermal transfer makes use of two important techniques: the Electric Thermal Ribbon (ETR) and the Thermal Carbon Ribbon (TCR).

In the first case, the heat necessary to transfer the ink to the paper is produced by the ribbon itself, and the print head only acts as the electrical conductor; in the second, the heat is produced by the print head itself.

Disk array and RAID

Disk array derives from the need for mass storage devices which are available, reliable, highly modular and relatively inexpensive. Starting from existing PC disk technology, a Redundant Array of Inexpensive Disk (RAID) can provide the same capacity as mainframe disk storage, but it is less expensive, more reliable and flexible (you can easily add new disks to the array) and, providing the appropriate techniques are used, it also provides faster data retrieval.

Disk arrays were generated in the Unix environment, but they are now used as "storage systems" for computers ranging from LAN servers to large mainframes. The basic idea of RAID is to manage the data stored on different physical disks in parallel. There are seven different types of RAID, using different techniques and with with different function and error-checking levels.

Multiprocessor and fault-tolerance systems

The introduction of multiprocessor systems offers greater processing capacity, but it also means greater overall availability and reliability for the system.

A multiprocessor system is highly modular, making it possible to add extra modules to ensure higher capacities without any migration of software into a different environment.

Of course, a multiprocessor system is more complex than a singleprocessor system, which implies a more sophisticated operating system and a different method of programming. Programming logic is normally sequential, making it difficult to take real advantage of the multiprocessor's characteristics.

Parallel processing

The response to the need for better processing performances is currently based on CPU developments offering higher clock rates and extended word lengths, RISC or RISC-like architectures and the ability to process several instructions in the same unit of time (known as parallel processing).

This last approach was first introduced in the supercomputer and TLC worlds several years ago, but it is only now that it it is also being used for microprocessor-based systems. The parallel processing logics used in this new context are SIMD (Single Instruction Multiple Data), MTMD (Multiple Instruction Multiple Data) and Neurocomputing (see *Figure 7).*

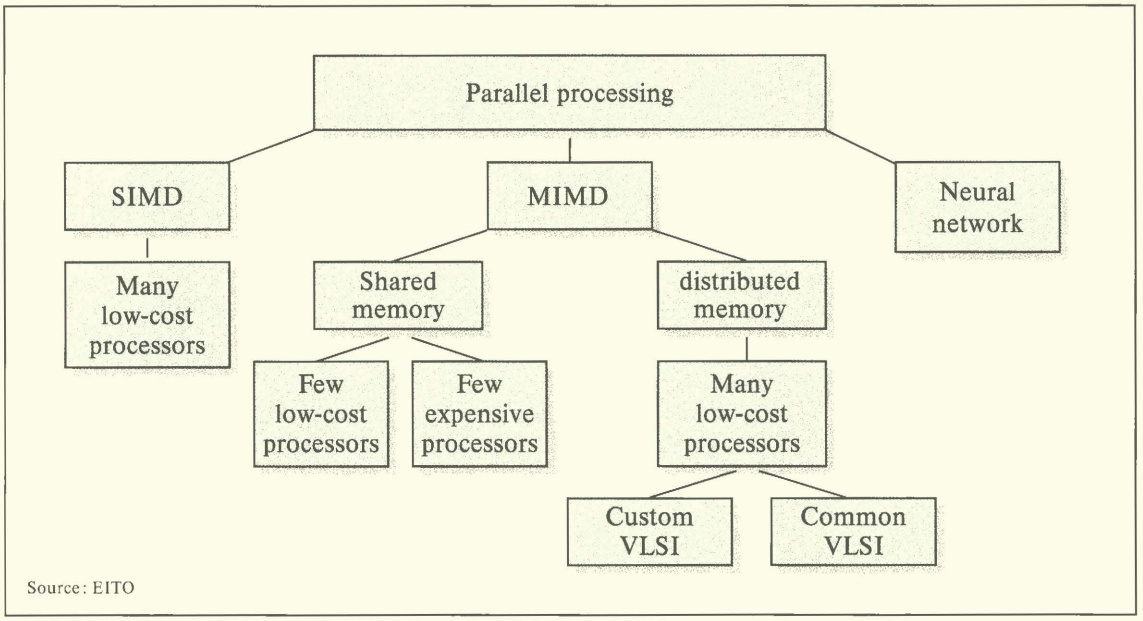


Figure 7
Parallel Processing

SIMD logic consists of an array (or vector) of processors, and was used in the first generation of supercomputers. It is now available in the form of high-performance chips. MIMD logic, which was very expensive with conventional processors, received lymph and renewed interest with the introduction of microprocessors.

As shown in *Figure 7,* MIMD logic has two different memory management systems: shared memory and distributed memory.

The third parallel processing technique is based on *neural networks*. The conventional use of neurocomputing logic is the simulation of neural networks on large mainframes, an expensive solution which is only really acceptable for problems of limited complexity. A new approach is now emerging with the implementation of neural networks on VLSI.

Neurocomputing and neural networks

Neurocomputing is a form of massive parallel computing performed by means of neural networks.

This concept was introduced in order to solve complex problems, such as automatic car driving or the automatic understanding of speech, which could not be specified by means of algorithms. However, solutions to problems of this kind (easily found by human beings) share a common feature: they imply the ability to associate objects from one domain with those of another.

Neural machines establish relationships among objects in relation to external events. When an "algorithmic" approach is used, relationships are "pre-defined" and clearly stated. A neural system establishes these relationships in an "adaptive" way by moving within a recursive and continuous feedback cycle that begins with an initial example, or beginner model. This recursive process allows the machine to *"learn".*

The neural network reproduces a raw model of the human brain.

Neural computing is based on a neural network which, conceptually, consists of processing units interconnected in a mashed net.

First level processing units process the input "signals" (events) and pass on the results to a second level, and so on until the generation of output "signals" (events). Each processing unit can receive various types of signals, but send only one signal to the other connected units. The connections enable the information to be propagated.

Each unit memorises previous elaborations and the values of the adaptive coefficients. An adaptive coefficient (or "weight") is assigned to each connection and rests in the memory of each processing unit. The fact that it can also be modified is fundamental in determining the signal flow.

Modification of these weights enables the whole system to be correctly adjusted.

A neural network can be characterised by its learning method, topology and adaptive coefficients, as well as by its various possible implementations - optical, electronic, optoelectronic, etc.

In different implementations, neurocomputers are usually on the market as coprocessors, associated with an ordinary computer via a bus or LAN and dedicated to the solution of certain specific problems. The main improvements regard the use of multiprocessor systems, the broader range of possible applications and the use of high-level languages for the reconfiguration and redefinition of the neural network.

Multimedia systems

A multimedia system is normally a PC or workstation-based machine linked to various "media" peripherals: sound processors, advanced video boards, high-definition touch-screen TVs, colour scanners, optical units (CD-ROMs) and high-capacity hard disks. It requires both basic and specific (or specially designed) software in order to develop the "screenplay", synchronise information (images and sounds) and design interactive paths for consultation purposes.

A great boost has been given to multimedia technology in recent years by the development of optical technology (see *Table 1);* further incentives have come from digital technology and the compression of audio and video information. A brief list of these technologies follows.

Compact Disc Digital Audio (CD-DA), has now become the most commonly used means of digital sound reproduction. Each CD-DA can contain up to 74 minutes of digital audio stereo recordings.

Compact Disc Read Only Memory (CD-ROM) has inherited the data storage format of the CD-DA and become the international standard for using digital technology to store any non-audio information. CD-ROMs, which have a 660 Mbyte memory capacity, are used to create and handle digital optical data banks on personal computers. However, their speed in transferring information from the drive to the central processing unit (about 1 Mbit per second) is slower than that of magnetic memories. This restricts their use in the field of moving images, which requires particularly high transfer speeds.

Digital Video Interactive (DVI) is the first form of digital video technology available on the market: it can memorise up to 72 minutes of moving colour video sequences on a CD-ROM,

Table 1
Development of Optical Technology

Optical memory	Announced	Characteristics	Standard
Analogue: Videodisk	1978	Analogue support for storing still and moving images	
Digital:			
CD-DA (Compact Disc Digital Audio)	1982	Standards for the digital recording of audio signals	
CD-ROM (Compact Disc Read Only Memory)	1983	Standard for the physical and and logical management of digital optical files for personal computers	ISO 9660
CD-I (Compact Disc Interactive)	1988	Standard for the digital storing and management of audio and video signals (with different quality levels)	ISO 9660
DVI (Digital Video Interactive)	1987	Technology for the management of full screen digital video on PC (stored on CD-ROM)	
CDTV (Compact Dynamic Total Vision)	1991	System for the digital storing and management of audio and video signals	ISO 9660
CD-ROM XA (Compact Disc Read Only Memory Extended Architecture)	1988	Extensions of CD-ROM standard with certain specifications of the CD-I	ISO 9660
Photo CD	1990	System for storing colour images from ordinary rolls of film in digital format on re-writable discs	Compatible with CD-ROM XA and CD-I

Source: SMAU

and these can be processed on a full-sized computer screen. Its capacity is therefore twice that of the analog videodisc. DVI technology can also handle digital sound.

Compact Disc Interactive (CD-I) brings the features of CD-DA and CD-ROM together on a single disk. CD-I players are specially designed for connection to all home TV sets and/or hi-fi units. The disks fall within the ISO 9600 standard and can decode four different levels of audio quality: from the highest quality levels of CD-DA (with which it is compatible) to low-quality mono sound (such as that from a medium-wave radio broadcast). The CD-I can be used with television sets conforming to both the European PAL (25 images per second) and the American/Japanese NTSC standard (30 images per second).

Compact Dynamic Total Vision (CDTV) is another interactive multimedia system based on the CD-ROM and aimed at the consumer market. Like CD-I, CDTV can reproduce texts, high-quality sound, still images, animated graphics and film, although only on a part of the screen at present.

Compact Disc Read Only Memory Extended Architecture (CD-ROM XA) is an update of the CD-ROM specifications which conforms to the ISO 9660 standard. Unlike CD-ROM, CD-ROM XA uses the technique of "interleaving" (recording different kinds of information on neighbouring sectors and in different modes) to give an improved synchronisation of audio and video. It shares some memory formats with CD-I (such as the five levels of sound quality), and this means that the space dedicated to sound can be optimised in relation to the quality of sound actually required.

Photo CD system has a read-write compact disc which can store colour images (up to 100 photos) in digital format from ordinary photographic film. Images can be stored at five different levels of definition (from low to very high) according to user requirements. Users can visualise and use Photo CD images on computers by means of a CD-ROM XA player. The system is compatible with the CD-WORM (Compact Disc Write Once Read Many) standard.

An important factor in the development of multimedia technology is the availability of author systems, that can process various kinds of multimedia information and manage the links between them.

4.2. Architectures

Such a continuous and highly dynamic evolution in the world of computers, the rapid development of new services and products, and growing end-user needs for new applications and services, would appear to require the constant reshaping of the whole information system; but this needs to be balanced against questions concerning investments and assets. In order to manage this ongoing reshaping process effectively and economically, a company needs the definition of a suitable Comprehensive Enterprise Architecture (CEA).

The main needs that CEA has to cover are *interoperability* among heterogeneous systems and *software portability* among different platforms.

In the evolution of architectures, standards have played and will continue to play a fundamental role. During the 1970s and 1980s, two standards (one *de jure* and one *de facto*) were generated for computer networks: the Open System Interconnection (OSI) reference model of the ISO, and TCP/IP-Internet. Albeit in different ways and at different times, all of the proprietary architectures have adopted these standards.

Most of the efforts in the past concerned interconnectivity; today, the main area of focus is that of interoperability. This primarily involves the "application layer", and depends on the different typologies and "portability" of applications which require standard platform interfaces in different hardware environments.

The main battle among global system manufacturers, in particular as far as transactional and distributed environments are concerned, is now over "application architecture" and the related "application development environment".

The concept of *open systems* has been developed, but what does it really mean? The term has two different origins, and is therefore often used with different meanings - thus increasing the terminological confusion. In the OSI context, an open system is a system that supports the complete range of OSI protocol pile, and can therefore be interconnected and interoperate with other open systems; in the mid-range and operating-system areas, open systems are Unix-based systems capable of providing software portability. What we can say is that an open system is any system characterised by a high degree of interoperability and portability; it therefore does not necessarily have to be a Unix system, although it is true that, up to now, most of the systems which can be scaled on different hardware platforms have been mainly Unix-based (or congruent with POSIX and X/OPEN interfaces) and have used TCP/IP or OSI protocol piles.

An open system is a key element for distributed systems which, in their turn, are playing a key role in new information system architectures.

Distributed systems and processing

Researchers have been talking about distributed systems for a number of years, and various studies and prototypes have been developed. But the great move towards distributed systems is now being propelled by the spread of LANs and "LAN-centric" logic, and the related spread of *client-server computing,* which ties the interlocutors into a master-slave relationship. Client-server logic lies at the heart of the *Network Operating System* (NOS).

A more general and balanced approach to application interoperability is provided by *cooperative processing;* by means of a suitable high-level protocol, two (or more) processes can be synchronised and run simultaneously on different machines in order to perform a "distributed process" that also handles distributed data.

The reference points for "distributed processing" are now:

a) *de jure standards,* consisting of the services and protocols offered by the "application layer" of the OSI model:

- DTP, Distributed Transaction Processing, DIS 10026 (1..3);
- CCR, Commitment Concurrency and Recovery, IS 9804, 9805;
- ROSE, Remote Operation Service Element, IS 9072 (1..2);
- RDA, Remote Data Base Access, DIS 9597 (1..2).

Together with the activities of ISO and CCITT, the IEEE effort towards POSIX interfaces is now very meaningful. As far as LAN standard specifications are concerned, IEEE recommendations are often converted into *de jure* standards and formally included in ISO recommendations. POSIX is therefore already playing a key role in this context, and will increasingly do so in the future.

b) *de facto standards,* championed primarily by certain international consortiums and associations:

- X/OPEN;
- DCE (Distributed Computing Environment) from OSF (Open Software Foundation).

c) certain *proprietary solutions,* provided by the main proprietary architectures (such as IBM's LU 6.2 SAA/SNA) by "specialised" environments (such as Tuxedo and Transarc for distributed OLTP) or by distributed data bases (such as Oracle and Informix).

X/OPEN model

X/OPEN is an ICT manufacturers association set up in 1984 in order to define a Portability Guide (XPG) for source software. Now at its fourth release (XPG4), XPG is a requirement for a number of public procurements.

X/OPEN does not provide a set of standard recommendations but, by using "an intercept strategy", refers to the most consolidated or promising standard solutions for establishing a Common Application Environment (CAE). *Figure 8* shows the DTP model and introduces two main high-level interfaces:

- the TX interface between user application and transaction manager, which "standardises" the present different interfaces to different resource managers (such as file and database systems);
- the XA interface between two transaction managers and the specific resource manager.

In other words, the TX interface defines a "standard" API (Application Programme Interface) for access to the (distributed) resources, API that might substitute the RM interface which is specific for each resource.

DCE from OSF

DCE, Distributed Computing Environment, is the reference architecture for distributed systems defined by the Open Software Foundation, a consortium of the major EDP manufacturers. DCE does not define a standard architecture but, very pragmatically, puts together a set of present technologies and both *de facto* and *de jure* standards in the distributed environment.

The DCE architecture, shown in *Figure 9,* might be viewed as a detailed sublayering of the higher OSI layers using the operating system and the lowest first four OSI layers, up to the "transport layer".

The distribution processing logic is based on "threads", a thread being an elementary unit for CPU assignments. The dimension of such a unit is very small in comparison with a usual process or task and therefore facilitates the parallelism required for distributed processing: instead of "multi-tasking", a DCE man speaks of "multi-threads".

DCE architecture is based on a client-server relationship with the Remote Procedure Call (RPC) for the message exchange between two cooperating processes. As *Figure 9* shows, "security" and "management" are key elements for DCE: the former is based on the "authentication" of users, messages and resources also provided by means of Kerberos cryptography.

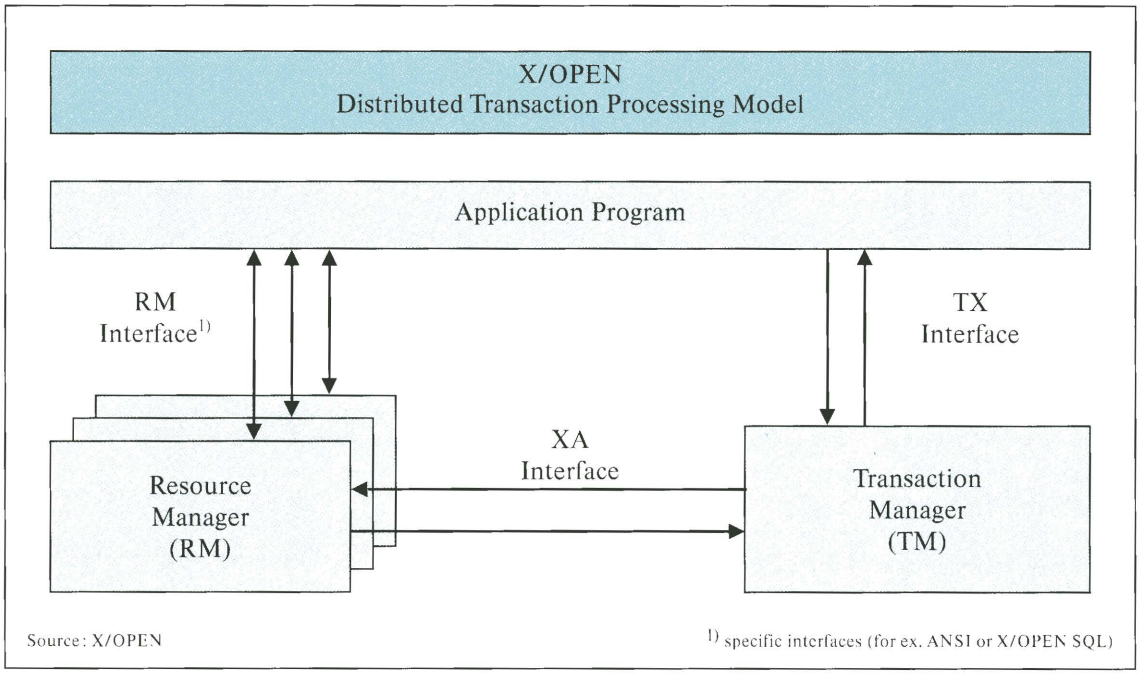
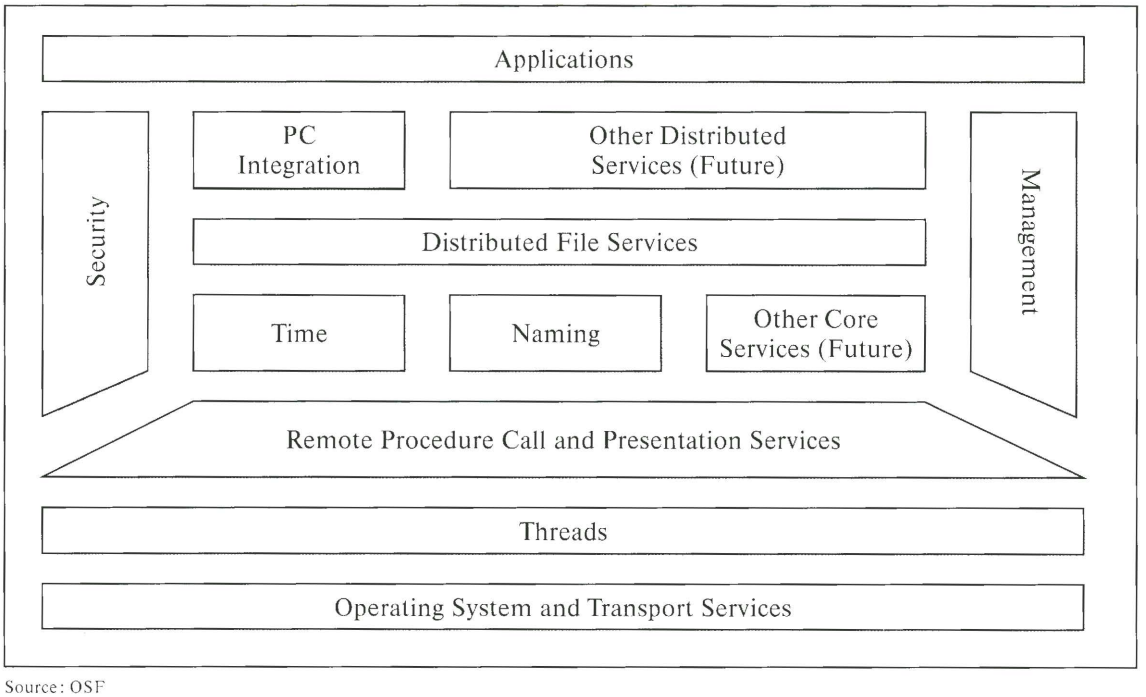


Figure 8
X/Open Model



Source: OSF

Figure 9
Distributed
Computing
Environment

POSIX

POSIX emanated from an IEEE working group, and its aim is to define the levels of interface for the operating system alone in order to allow the portability of the operating system and the application software in C on different platforms.

Unix System V was chosen as a basis. However, the POSIX specifications also include functions and interfaces deriving from BSD version 4.2/3.

It is important to stress that POSIX does not define an operating system, only the interfaces.

POSIX is structured in different working groups, whose labels also identify the related recommendation (1003.0 for Operating Environment Guide, 1003.1 for System Interface, and so on).

System and Network Management

Over the last few years, there have been many important innovations in control and management systems, both in proprietary architectures and in the international ISO standards in the OSI reference model. This coincidence is a clear indication of how network management is one of the key factors for the development of company information systems in the 90s.

The increasing complexity of both the network and, more generally, the information system, requires greater automation in the control and management of resources, as well as auxiliary tools for identifying or solving problems. In this context, expert systems are beginning to play an important role. In 1989, work was completed and published on the definition of the architecture for ISO's Network Management System, CCITT's X.500 Directory Service, as well as for proprietary systems such as Netview Release 3 for the IBM SNA networks, Open View from Hewlett Packard, EMA from Digital and UNMA from AT&T. The most significant OSI NMS recommendations concern:

- the OSI management framework;
- OSI systems management;
- models and structures of information for management (SMI, Structure of Management Information).

The OSI management approach:

- concentrates the main functions, services and protocols on the application layer;
- is based on a client-server logic;
- considers different functional areas regarding the management of configuration, faults, performances, security and accounting;
- introduces the MIB (Management Information Base) for each managed "open" system, which includes all the "managed objects" and their attributes;
- uses the "managed objects" for controlling and monitoring the system with an actual "object-oriented" logic.

Figure 10 shows a diagram depicting the logical hierarchy of the various objects.

A *de facto* standard is emerging on the market, thanks mainly to the diffusion of LANs. This is the *Simple Network Management Protocol (SNMP).*

SNMP originates from the TCP/IP and Internet architectures. It is conceptually very close but much simpler than the OSI logic, and several manufacturers have developed it on different platforms. For some of them, SNMP represents a transitory step before OSI CMIS-CMIP. Other

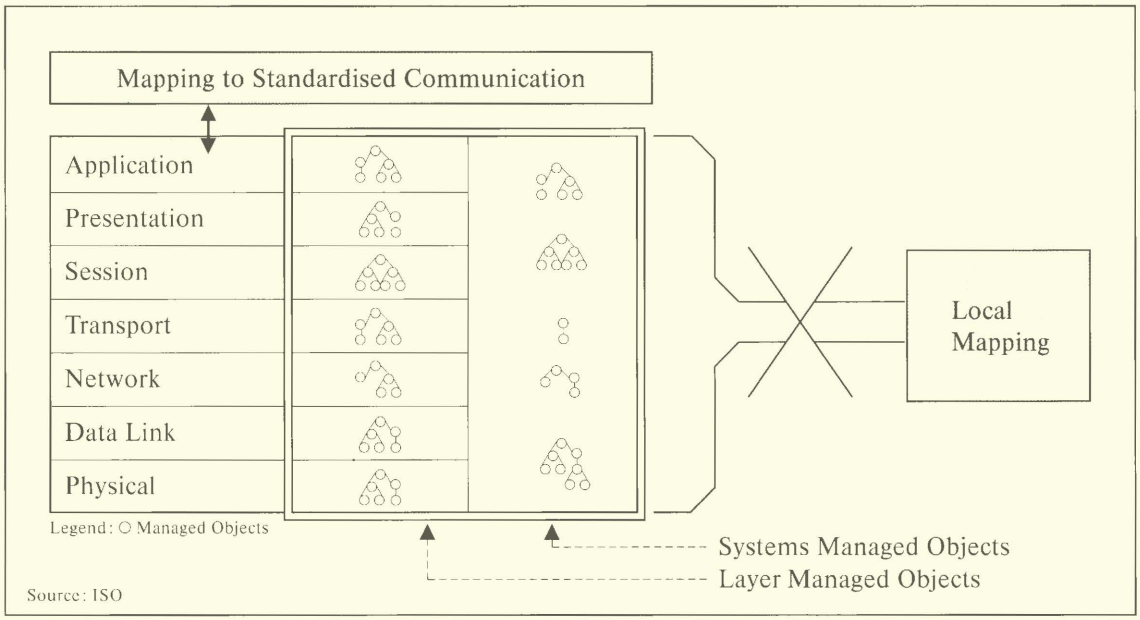


Figure 10
Systems Management Application

manufacturers consider SNMP as a consolidated de facto standard which is alternative to OSI. It is significant that practically all of the proprietary architectures include SNMP, CMIS-CMIP or both, and that the companies are announcing the first releases.

There has also been a great deal of activity on the part of user and supplier associations (such as the Network Management Interest Group of the OSI Implementation Workshop and the OSI Network Management Forum) in the production of prototypes, showcases and implementation programmes based on "stable implementation agreements". All of these approaches and solutions are based on a set of emerging design and implementation logics:

- the logic of object-oriented design, which sees the resources it must control as objects characterised by their technical and functional attributes;
- client-server logic for obtaining information from the various network units and interacting with the various distributed central systems for management purposes;
- the logic of cooperative processing for the handling of network management data in different environments which can be carried out on a single intelligent workstation.

4.3. Software Technology

Microelectronic and computer technologies are the pillars of evolution and progress in ICT, but it is software technology which will determine the penetration and speed of user acceptance of solutions for scientific, industrial, corporate and services problems. Software technology now has to bridge the real gap between currently enormous hardware capacity and the end-user's ability to use it. During the 1990s, software will play a major innovative role by creating new solutions and generating significant changes in end-user behaviour at home and at work.

Software innovations are continuous; practically every new development introduces innovation. According to the statistical section of EITO, the software sector is subdivided into:

- system software and utilities (also called "basic software"), which mainly includes operating systems;
- application tools (also called "middleware"), which include all environmental software from graphic interfaces (such as Windows) to communication software, relational data bases and the development environment, and from languages to CASE (Computer Aided Software Engineering) tools;
- application software, which includes all of the software solutions for specific problems.

Standards have been and are still being defined for software technology, in particular in the fields of portability and interoperability.

Certain new services and the related application software will be considered in section 6.

Operating Systems

All of the proprietary operating systems for mainframes and minicomputers have introduced innovations: cache memory, the widening of address spaces, the adoption of the new standard APIs (POSIX, X/OPEN, etc), new security mechanisms for access control, user authentication, digital signature and data confidentiality. Over the last two years, the main interest has been focused on desktop operating systems, where there is strong competition among DOS systems, OS/2, Unix, Apple System 7, Sun Solaris, Open Desktop, the announced Windows NT and PowerOpen, and the "next generation" Pink, with related GUI and API supports.

Trends in operating systems are focussing on portability and interoperability, and therefore on "open systems" objectives. In this context, the main elements are:

- high-level Application Programming Interfaces (API);
- user-friendly graphical interfaces;
- network services;
- multiprocessing support;
- layering into linked but autonomous objects;
- the introduction of microkernel logic.

Microkernels

Microkernels are operating-system kernels which provide basic services (particularly interprocess communication, scheduler and memory management) in very few kilobytes. The microkernel isolates all hardware-dependent characteristics, and is therefore portable onto different nodes of a multiprocessor or distributed system.

On the top of a microkernel, different specific modules provide the classic functions of a higher-level operating system, such as independent "sub-systems" (for example, device managers, file manager, etc).

Microkernel logic was initially developed for real-time embedded systems, as seems to be the case of Chorus from France Chorus Systèmes (now in joint-venture with USL, Unix System Laboratories) and MACH from MIT, Massachusetts Institute of Technology.

The microkernel approach is now being followed in particular for Unix environments, where it should drastically reduce the required memory size, "integrate" basic functions and "reduce" the complexity of current solutions (which are normally heavy, inefficient and difficult to manage, use and learn).

Graphic Interfaces

Another important technological item is the graphic user interface (GUI). A GUI is an interface which uses graphic symbols (icons, windows, and so on) and therefore appears more intuitive than an alphanumeric command system. Instead of a cryptic command-line interface, the user sees a graphic reproduction of his desk on the screen, with the familiar tools (folders, pocket calculators, a waste basket) and acts on these object-icons using a mouse.

Furthermore, GUIs encourage the creation of links between applications, facilitating the switching from one memory resident application to another. In this manner, GUI is changing from being an application programme to becoming an operating system (or rather a platform, taking on a standard role as a system of graphic communication).

However, GUIs require a lot of CPU work and only the latest generation of PCs and workstations can run them at reasonable speed.

Object-Oriented Analysis (OOA) and Programming (OOP)

Conventional software development was founded on the concept of "modular" and "top-down" techniques which tried to design a programme starting from the definition of the main tasks and then repeatedly breaking them down into smaller and simpler units.

The growing complexity of the problems that an information system has to solve and the increasing difficulty of programme management require a new approach and new tools for the analysis, specification and development of information systems.

The "object" is an "abstraction" of a "thing". Everywhere in the real world, we see objects: desks, lamps, cars . . . Every object has certain properties (colour, dimension, weight) that are called "attributes" and may perform certain actions when one or more particular events occur (a lamp will light when we switch it on). These actions define the "behaviour" of the object.

A "complex object" is usually composed of several simpler ones, each with its own properties that define the properties and behaviour of the whole.

An object is fundamentally a collection of data elements with some procedures (or methods) for manipulating the data.

OOA was created with the aim of focussing on the significant aspects of the problem domain and the system's responsibilities, by drawing together a number of previous analytical methods and disciplines.

OOA provides an information model based on objects and their attributes, services and relationships with other objects (structure); OOP provides the tools for developing software according to the information model defined by OOA.

OOP took its first steps in the late 60s with the SIMULA language, and then made significant progress with Algol and Pascal. Currently, the most widespread "object-oriented" languages are Smalltalk and C++.

In OOP, an "object" is a run-time instance of certain processing and values, defined by means of a "static" description called a "class". These properties simplify the work of a programmer: it is possible to interface an object from a functional point of view without knowing its internal structure; and therefore it is possible to use complex objects, defined by others, as library programmes. It is also possible to modify an object's internal structure without changing its external behaviour (methods). OOA and OOP provide a

new paradigm for software design and development, putting the object, data and possible operations together in the same logical unit. This approach requires a modular logic, but it increases the developer's productivity by allowing the use of predefined common modules and programming for "differences": an application becomes easier to manage and to modify.

It is important to point out that several ISO standards now refer to the "object-oriented" concept. For example, the OSI Network Management System defines the information model and the related structure of management information in terms of a "management object".

Databases

The database context is now dominated by relational databases, particularly for departmental hosts and open systems. The main evolutionary trends are focused on "distributed" and "object-oriented" databases (relational or otherwise), and they also have a great impact on DDLs, Data Definition Languages, and query languages.

Standards are also in the arena: SQL was a *de facto* and is now a *de jure* standard; the ISO RDA, Remote Data Base Access, specifies the access method for distributed databases.

CASE

Computer Aided Software Engineering (CASE) and all of the other "application development tools" are evolving in line with the evolution of software. Both Component-CASE (C-CASE) and Integrated-CASE (I-CASE) include multi-windowing and graphic interfaces. They support different types of application environments (OLTP, client-server computing, CICS, IMS, etc) and languages and databases (Cobol, PL/1, C, ADA, DB2, Oracle, etc). They also support and are portable to different platforms and different operating systems.

The new OOA and OOP logic will be accepted both at the design and methodological, and at the code-generation level. Expert systems and Artificial Intelligence logics are also used.

Re-usability, Repository and Re-engineering are considered the key factors for CASE, and there is also growing interest in the emerging standards and software quality certification defined by the ISO 9000 recommendations.

5. Telecommunications

Although the trend towards a "full digital approach" and computer and communications integration seems to overlap and fully integrate the worlds of information systems and TLC, market supply and demand have remained mainly separated up until now. Historically, TLC manufacturers approached the "public" and the "private" networks with different logics and services/systems/products, as they considered the "private" environment a less reliable, less available and less powerful "sub-derived" system. Now, the "public" and "private" environments are increasingly considered as distinct entities focused on specific functions, regardless of the fact that they must be interconnectable and that TLC units are based on the same ICT technologies.

TLC trends are even more strictly tied to components and computer and software technologies, partially as a result of digitisation and secondly because of growing integration. In the "global system of information" we refer to, TLC plays a key role as the "communication" infrastructure for information transfer.

5.1. High-speed Networks

The introduction of fibre optics and digital networks has brought about higher speeds and broader bands than in the past, not only at strictly

local, but also at wider levels. This trend in transmission lies at the basis of some important developments that are currently underway:

a) the development from optical-fibre LANs towards FDDI (Fibre Data Distributed Interface) systems and MANs (Metropolitan Area Networks) with QPSX/DQDB (Distributed Queue Dual Bus);

b) the development of narrow-band ISDN towards broad-band ISDN (B-ISDN).

At the heart of these new technologies there are two suppositions:

1) that new means of transmission (normally based on optical-fibre systems) are intrinsically more reliable than other similar networks and lines, and require much less checking and maintenance;

2) that, at the extremes of the connections provided by broad-band networks, there are "intelligent" systems to check and correct possible errors.

The speed of the means of transmission available today must not be "choked" by processing activities aimed at correcting errors or at routing the present techniques, which are used for an analog environment with a high degree of error.

Figure 11 outlines the development of broad-band technologies and services. The two technological paths of FDDIs and FPS (Fast Packet Switching) relate to two different environments. FDDIs are found mainly in the local environments typical of LANs; FPS in digital public networks (making it more correctly a development of ISDN). FDDIs are mainly oriented towards data, text and still images; while FPS is also oriented towards the integration of voice and moving images.

DQDB is the reference standard for MANs, even though several implementations are currently using FDDI.

FPS

Fast packet switching techniques differ considerably from the packet switching defined in the CCITT recommendation X.25. In general, these new technologies simplify the transmission of digital information through a network, sacrificing some of the X.25 capacities. One of the main losses is the spotting of errors. X.25 places error location and correction within the network itself. The new technologies give this responsibility to the network's terminal systems.

By using fast packet switching techniques, delays can be reduced to such an extent that even delay-sensitive information (such as voice and video) can be transmitted. FPS techniques can be divided into two main families: those based on frame relays and those based on cell relays.

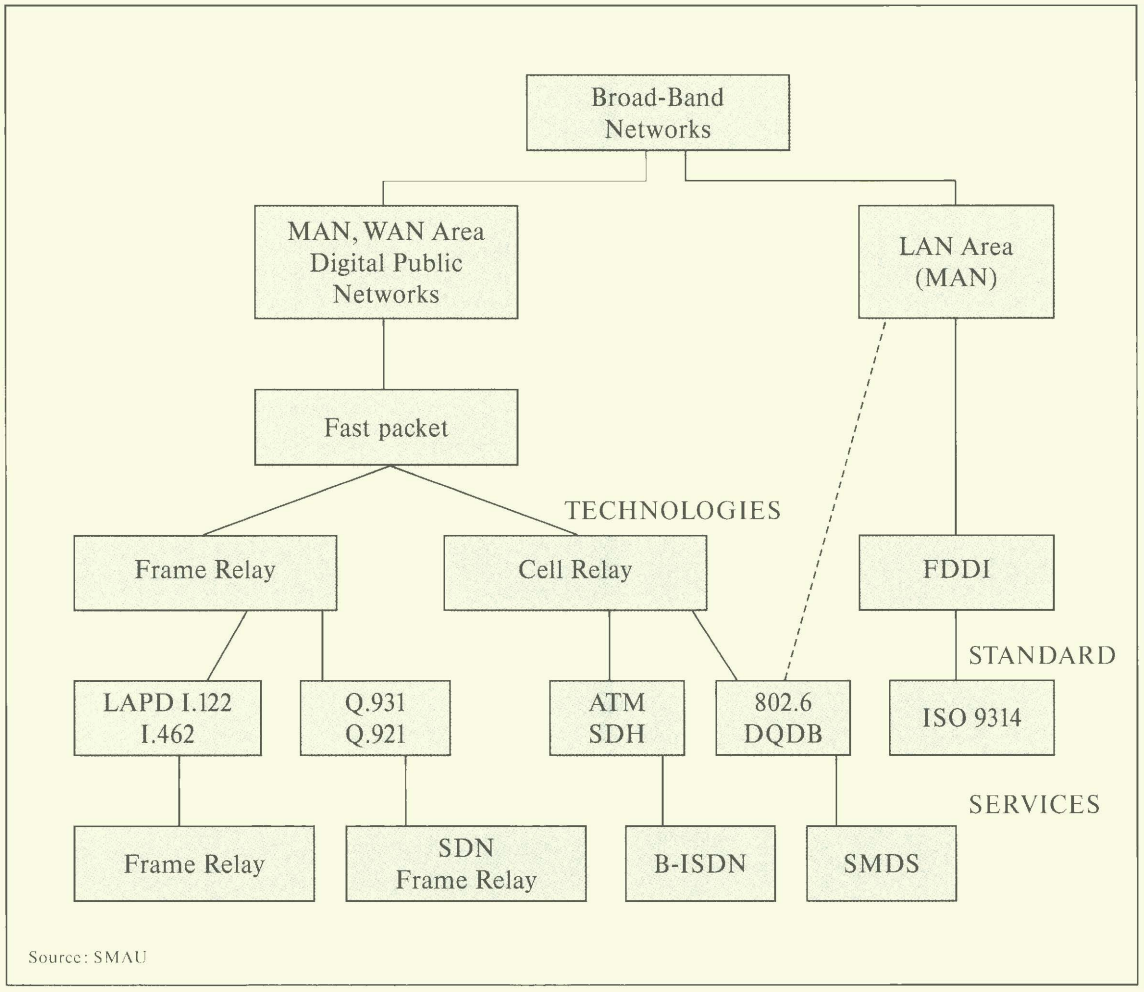
Frame Relays

Basically, the frame relay is an interface between a local environment (generally a LAN) and a high-speed wide-area network with variable-band packets and with an overhead reduced to the minimum to lessen protocol processing times. The frame relay is based on the CCITT I.122 (LAPD) standard and refers to the Q.931 protocol for the call setting of virtual circuits, and to CCITT I.462 (X.31) for the "support of packet-mode terminal equipment by ISDN". The frame relay is an interface and it is not specified how it should be used between one switching point and another; protocols and proprietary logics are being developed.

Cell Relays

Unlike frame relays, the cell relay is a method of access to high velocity for broad-band networks. Cell relay technology is based on fixed-length units of information called cells, as defined by the ATM (Asynchronous Transfer

Figure 11
Development of Broad-Band Technologies and Services



Mode) standards as far as switching is concerned, and the SDH (Synchronous Digital Hierarchy) as far as the transmission architecture is concerned. These two standards are the supporting pillars of the future broad-band ISDN.

ATM

ATM (Asynchronous Transfer Mode) is a multiplexing and switching technique relating to the first two functional levels of the ISO-OSI model. ATM is defined by CCITT as a transmission mode in which information is organised into cells. It is asynchronous insofar as the resort to cells depends on the required bit rate. All of the information is transferred in fixed-length units known as cells. CCITT defines the characteristics of cells in terms of speed, dimension and format. The essential characteristic of the ATM tech-

nique is the reduction of the processing activity at each individual point to a minimum, in order to increase the speed of transit. ATM enables the allocation of speeds, and therefore bands, on demand; and the channel mix available on the interface can be allocated and changed dynamically. In practice, all available transmission bands can be bundled in accordance with the requirements of the various kinds of service.

ATM maintains some features of packet and circuit switching. From packet switching, it has taken the statistical multiplexing of various flows/sources on specific physical links, and therefore a variable delay in passing through the network. From circuit switching, it preserves the simple, fast point-by-point processing of cells, delegating the role of checking and correcting possible errors to the intelligence present at each end of the connection.

SDH

The SDH (Synchronous Digital Hierarchy) transmission standard is the international specification issued by CCITT and based on the USA proposal SONET (Synchronous Optical Network). The main aim of this standard is to define the way in which the multiplexing of more than one digital flow is carried out at various speeds in a single transmission carrier (an optical-fibre cable, for example). The SDH standard has various significant advantages over the PDN (Plesiochronous Digital Network) so far used for digital means of transmission.

The following advantages are worth mentioning: the vast amount of information on transmission systems using SDH allows great operating advantages in the use and maintenance of equipment; high operating flexibility; the insertion or removal of digital flows at various speeds; compatibility between equipment made by different manufacturers.

5.2. Mobile Communication

The explosion of telecommunications in motion (particularly that of mobile telephony) has created a mass market. The spread of cellular technology has led to the development of an extremely wide range of new services. Telepoint, personal communications networks, telephones on board aircraft, cordless LANs, radio-locating services using satellites and radio data-transmission systems are only a few of the options available to an increasing number of users.

The first systems installed were of the analog kind, mainly functioning on the 450-MHz band. Their use is generally restricted to the main cities and subscribers generally fall into the category of business users.

The market explosion has led several countries to introduce an analog link-system operating at a frequency of 900 MHz. All of this development and the diversification of services is based on an extremely scarce resource: the frequency spectrum.

This factor is giving rise to the increasingly urgent need to introduce digital systems, which not only offer more sophisticated services (voice and data), but above all allow a much better exploitation of frequency resources.

The *pan-European GSM (Groupe Speciale Mobile)* provides a global system for mobile communication, and is going to become the main digital infrastructure for voice and data digital TDM (Time Division Multiplexing) mobile services. In fact, the GSM system will be simultaneously introduced in many European countries by opening the system up to competition. GSM will also be the basis for PCMs (Personal Communication Networks), and the related PCSs (Personal Communication Services).

In Europe, the PCN is already a standard awaiting ETSI approval. The PCN project (DCS 1800) will be based on the 1.8 GHz development of the GSM. As such, it should benefit from all of the standardisation and testing activities which will be carried out for the pan-European system.

Table 2 shows the standards we will refer to for mobile communication. Mobile communication products include conversation radio-telephone terminals for the public service, private radio-telephone terminals and apparatuses for private communication networks, telephone paging-system terminals for the public service, and private paging systems in local environments.

5.3. Cordless LANs and PABX

There are three solutions to CLANs, each of which uses a different part of the electromagnetic spectrum (see *Figure 12):*

- Spread Spectrum Technology (SST);
- Microwave;
- Infrared.

The principal difference between each of the techniques is one of obstacle penetration. The higher the frequency, the greater the attenuation of the signal when it hits a physical obstruction. Attenuation is the propensity of a signal to weaken as it passes along a transmission path, the degree of attenuation being determined by the resistance it encounters.

Table 2
Mobile Communication Standards

Standard	Definition	Band	Technique
CT2	Cordless Telephone	864-868 MHz	Digital FDMA*
CT3	Cordless Telephone	800-1,000 MHz 900 MHz	Digital TDMA**
DECT	Digital European Cordless Telecommunication	1,700 MHz	Digital TDMA**
GSM	Global System for Mobile Communication	900 MHz	Digital TDMA**
PCN (DCS 1800)	Personal Communication Network (English version)	1,800 MHz	Digital TDMA**
PCS (USA)	Personal Communication Services	Different frequencies	
ERMES	European Radio Messaging System	170 MHz	

Source: SMAU

* FDMA: Frequency Division Multiplex Access
** TDMA: Time Division Multiplex Access

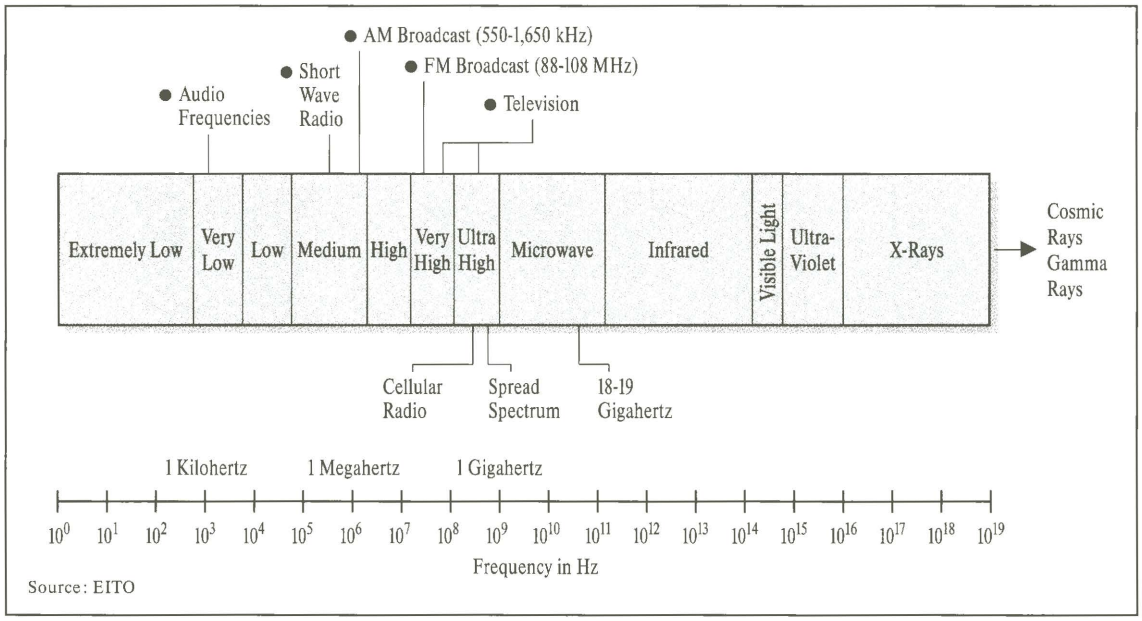


Figure 12
Electromagnetic Spectrum

The greatest advantage of cordless PABX (Private Automatic Branch Exchange) is the possibility of expanding the number of extensions and changing their location without needing to undertake building or installation work. In the data-transmission area, the opportunities opened up by cordless PABX could be extended with the "cordless modem" that sets up a connection without a fixed extension; and the same could apply to fax.

5.4. Satellites

A very important innovation for the future of European satellite services was the publication of the EC Green Paper on satellites in November 1990. According to the EC, satellite services of the 90s cannot develop within an environment that is over-regulated, and far-reaching liberalisation is suggested. The EC Commission is convinced that satellite communications present no threat to the infrastructures of earth-based networks.

The most important technological development underway in space systems is the new generation of multibeam satellites, of which the first example, Intelsat VI, was launched in October 1989. Such systems allow a much more efficient use of frequencies and require smaller Earth-based receivers than the previous generation.

The development of VSATs (Very Small Aperture Terminals) has led to an increasing use of satellites in private company networks over recent years.

Many large users and suppliers of services are incorporating satellite technologies in their networks.

Among the application fields for satellite technology, television and telecommunications are at present more or less equal in importance.

In the area of radio communications, growing use of satellites is being made in radio-locating and message transmission services, which are particularly useful in the transport sector.

6. New Services and Applications

In every field of human activity, ICT is now offering tools and solutions for significant improvements in both the quality of the work and the productivity of the end user. By definition, an "application" is a "vertical solution" to a specific problem; therefore, each "vertical" sector is undergoing continuous and dynamic evolution. But from a technological point of view, the main characteristic of most innovative services and applications is the "functional integration" between different technologies and logics. Typical examples are multimedia applications.

A second significant aspect is the current availability of standards.

At a "high" functional, the concept of integration can refer to different things: the integration of different types of information, the integration of different application architectures, the integration of the interaction between end-users and machines/applications. There is a lot of innovation in applications in all of these directions.

Increasingly powerful PCs and workstations, with new multimedia, speech synthesis and voice-recognition options, represent the new "integrated" interface between the human being and the system.

Significant innovations are also being made in the new generation of *office information systems,* where multimedia devices, decision support systems (based on expert and AI systems) and real interoperability with accounting systems are a constantly growing reality.

The trend is to provide increasingly "intelligent" support for decision makers by accessing and selecting the right information when, where and as necessary.

There are many tools which help professionals to do their work: simulation, project management and CAD/CAM systems, and presentation managers. Thinking systems interoperating with local and remote databases now exist on PCs and workstations.

Factory automation is an area where CIM (Computer Integrated Manufacturing, which includes CAD/CAM techniques) and robotics have already changed working styles, and where functional ICT integration is achieving significant results.

New education and training applications allow faster and easier learning. These tools, together with others, open up new working opportunities for disabled people.

Digital PABX with computers and multimedia workstations provide real "integration" in terms of both transmission and application, and they have already reached the goal of computer and communications integration, at least from the point of view of technological capability.

The evolution of public networks and services is also offering new "integrated" high-level services through the development of "intelligent networks".

6.1. Intelligent Network Services

The concept of an intelligent network dates back to 1986, when Bellcore (the research centre of the seven American regional telephone operating companies) coined the term and defined the first specifications (IN/1). Over the years, both the concept and the various services have taken on more precise characteristics with the release of further specifications, IN/1 and IN/2 AIN (Advanced Intelligent Network), broadly defined in 1990 through an MVI (Multi Vendor Interaction) interactive process. Along with the regional American telephone operating companies, developments have also involved 16 supply companies (suppliers of switching systems and information technology companies).

The term "intelligent network" indicates a telephone network architecture based on the separation of the transport from the signalling network (it is the latter which transmits information on call processing). The system provides access to databases containing supplementary information which radically alters the service offered. The separation of the supply of the service from the processing of calls allows the rapid introduction of services by using software platforms which are developed independently of the kind of exchange used.

In the main, the advantages for telephone operating companies of introducing such an architecture are a more efficient allocation of network resources and the possibility of extra income deriving from the supply of a large number of additional services.

The main intelligent network services are:

a) Freephone: these are calls paid for by the receiver with special features such as variable routing of calls according to the geographical source of the call or the time of day, the selective blocking of calls and the distribution of calls to various offices according to percentages defined by the user. These facilities are already available through intelligent pre-networks. These pre-networks can be modified by the users themselves (the customer control service) by accessing the management system in order to alter the system set-up directly.

b) Charge calls: these give access to information services supplied by third parties (service suppliers) and forwarded by the network. Callers are charged for the cost of the call as well as the cost of the service. These systems can make use of the same programmable facilities as those of the freephone services. This family also includes tele-voting or tele-polling services (for research and surveys), where callers dial the phone number of the service and then add other numbers (e. g. 1 for yes, 2 for no) to express their preference.

c) Peak call handling: this guarantees normal telephone traffic by providing selective blocking and alternative routing at times of peak calls due to special events, television programmes, etc.

d) Near-private networks: these provide users with "made-to-measure" private telephone networks within the public network by means of specific software. The main features of the system are a private numbering system, selective blocking of calls, proof of call, authorisation code management, transfer of calls, management of special charging methods and customer control.

6.2. Application Standards

As described in Part One, Information Technology Standardisation, application standards are becoming increasingly important.

Several application standards have been or will be defined by ISO and CCITT, all aligned on the Application Layer (layer 7) of the OSI Reference Model. The most important standards refer to office document, electronic mail, electronic data interchange and application cooperative processing.

The main interest of ISO is now DTP (Distributed Transaction Processing) for "open" and distributed OLTP and RDA (Remote Data Base Access).

Due to the impact it has on the information system and the company operations, some reference must be made to EDI.

EDI

EDI (Electronic Data Interchange) defines a standard form for the electronic exchange of trading documents, such as invoices or purchase and payment orders. The EDI standard is EDIFACT (EDI for Administration, Commerce and Transport), sponsored by the United Nations, the

European Community and the European Free Trade Area. ISO 9735 defines the application layer syntax rules. The EDIFACT standard specifies the trading messages and the related design guidelines, syntax, segments and data elements. About 100 messages are currently under development, but only a few have reached Stage 2 final standard status (the other three stages are 0 for draft, P for "agreed proposal", 1 for "draft for formal trial").

The adoption of EDI is a significant evolution in corporate architecture, and has a real impact on working styles. The main benefits of EDI are:

a) more accurate recording: it is estimated that only 75% of manually entered data is correct; with EDI, the information goes directly from one computer to another without any manual intervention, thus eliminating the possibility of human error;

b) a reduction in data-entry costs;

c) a reduction in postal costs;

d) a reduction in the amount of paper in circulation;

e) better service for the client;

f) a reduction in storage costs: by managing orders in real time, suppliers and customers know exactly what goods will be delivered where without having to resort to inaccurate estimates; in general, it is estimated that the level of stock reduction will be in the order of 80%;

g) a better cash-flow: if the need arises to exchange documents (invoices, for example), there is less room for disputes if EDI is used, and payment and collection can take place more punctually;

h) better information for management: EDI provides immediate access to information relating to statistics on orders, supplier behaviour, a client's credit rating and transport costs/times.

Other application standards

FTAM (File Transfer, Access and Management) [ISO 8571 (1..5)], VT/VTP (Virtual Terminal/Virtual Terminal Protocol) [ISO 9040, ISO 9041 (1..2)], JTM (Job Transfer and Manipulation) [ISO 8831, ISO 8832] are the "traditional" application services and protocols that "virtualise" the file, the terminal and batch jobs on the network.

X.400 is a set of CCITT recommendations defining a "message handling system" which electronically emulates postal services. CCITT's first version (1984) is widely used in electronic mail products, and the new version (1988), which adds new functions, was accepted and ratified by ISO in 1990 as 10021 (1 . . 7). X.400 is now considered the message exchange infrastructure for all other messages standards, such as ODA/ODIF, EDI and MMS. X.500 and the accompanying ISO 9594 (1..9) define a directory service to be used on-line as the common, worldwide "yellow pages" for electronic mail. The services include the mapping of physical names with nicknames, a list of available services in the network, and the management of password and access rights for users. For office automation, a significant reference is the ODA/ODIF standard, ISO 8113 (1..10): ODA (Office Document Architecture) defines the medium for exchanging complex office documents such as letters, reports, notes, etc.; ODIF (Office Document Interchange Format) defines the formatting of the documents themselves.

For factory automation, the main reference standard is MMS (Manufacturing Message Specification). This standard defines machine-to-machine communication and introduces the concept of VMD (Virtual Manufacturing Devices) for interfacing different types of factory floor devices and robotics in the same way. MMS is specified as ISO 9506 (1 . . 4).

Information Technology Standardisation

1. Introduction

Standards can open up new market opportunities and unify market requirements. Standards can stifle product sales. Standards can remove trade barriers and create them. Standards can promote safety yet inhibit innovation. Standards can promote great advancements or even result in disastrous economical effects. Standards can cost fortunes and make fortunes. Standardization is a highly political and strategic matter and the executive who ignores it can be missing great opportunities and incurring enormous risks to himself and to his organisation.

The ubiquitous application of Information Technology (IT) including Telecommunication throughout science, industry, commerce, academy and almost every aspect of our highly communicative society is increasingly dependent on a hierarchy of timely, complex and internationally based standards.

In the field of Information Technology the user requirement to interconnect and communicate among systems of varying capabilities and architectures has posed a major challenge to international standardisation bodies.

Standards for computer hardware and software must be closely coordinated with standards and protocols for communications systems and networks. This has required the International Organisation for Standardisation (ISO) and the International Electrotechnical Commission (IEC) to cooperate much more closely with each other as well as with the International Consultative Committee for Telegraphy and Telephony (CCITT) of the International Telecommunications Unions (ITU) and many other international regional organisations.

The IEC and ISO have successfully combined their activities in Information Technology into a single Joint Technical Committee (JTC1) of huge proportions involving thousands of technical experts around the world. The creation of JTC1 has facilitated the cooperation among the non-intergovernmental organisations IEC and ISO with the treaty organisations ITU and CCITT. As a result, the many hundreds of highly technical standards needed are being produced.

The cost of producing IT standards is enormous. Thousands of people are involved from hundreds of organisations. In many cases those involved represent the most highly skilled and scarce talents that their organisation have to offer.

Successful production of the hundreds of standards needed for interoperability of information technology systems does not by itself ensure interoperability. Decisions as to which options will be used among and within the standards have also to be taken. This requires liaison among the standards writing organisations and those dealing with the selection of options in organisations such as COS (Corporation for Open Systems/USA), SPAG (Standards Promotion and Application Group/Brussels), POSI (Promoting Conference for OSI/Japan), etc.

Other significant contributors to the process are the European Computer Manufacturers Association (ECMA), the European Workshop for Open Systems (EWOS), the American National Standards Institute (ANSI) T1 Committee, the National Institute of Standardisation and Technology (NIST) as well as the Asian Oceanic Workshop for Open Systems (AOW).

Professional societies such as the Institution of Electrical and Electronic Engineers (IEEE) are also heavily involved in the IT standards process making key contributions such as the IEEE 802 Standard for local area networks.

The official standardisation structure includes "top down" as well "as bottom" up approaches in which national Standards Institutes send delegations of experts to the Technical Committees of ISO, IEC and JTC1. The results are implemented in national Standards on a voluntary basis. In Europe the regional (European) organisations CEN (Comité Européen de Normalisation) and CENELEC (Comité Européen de Normalisation Electrotechnique) seek by their rules that all European Standards (EN) will ultimately become national standards.

In the European Telecommunications Standards Institute (ETSI) some of the ETS (European Telecommunications Standards) such as the TBRs (Technical Bases for Regulation) become compulsory by transferring them into CTRs (Common Technical Regulations) by the European Commission.

Government interest and involvement in IT standardisation at national, regional and international levels is high. The United Nations, for example, is concerned with the need for Standards for Electronic Document Interchange (EDI).

The Organisation for Economic Cooperation and Development (OECD) has taken great interest in telecommunications liberalisation, type approvals and is now studying the overall standardisation process to see if it inhibits or advances economic advancement of its member nations. The European Community is heavily involved through CEN, CENELEC and ETSI to ensure that Standards are being delivered on time and that cartels are not being developed. Also the European Community is concerned that patents and intellectual property rights are not inhibiting the process. The fact that the Standards being developed within the IEC, ISO and CCITT process are in many cases being derived from the vanguard of high technology development raises important issues concerning patents and intellectual property rights.

In summary IT standardisation involves major resource expenditures, high risks in product development and marketing, patent and intellectual property rights, political and image issues, regulatory controls and trade barrier considerations as well as a host of other strategic issues. However, it must be noted that standardisation establishes the larger market size needed to pay for the growing investment in research and development required by the IT-industry and its users. Accordingly standardisation is not a subject to be ignored: it must be throughly understood and intelligently dealt with on a strategic basis.

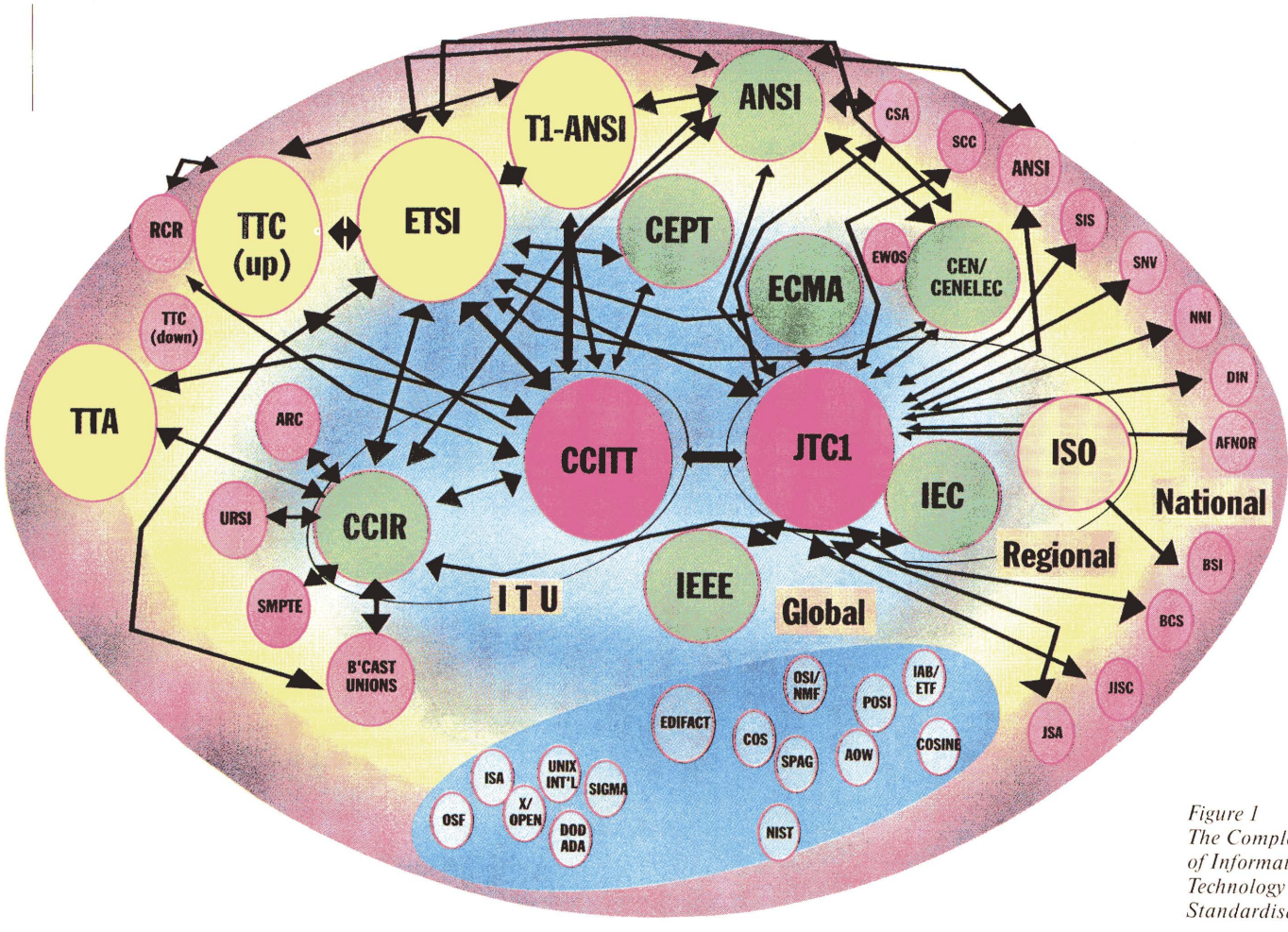


Figure 1
The Complex World of Information Technology Standardisation

2. The International Scenario of Standardisation Efforts

In the technical world clearly agreed specifications, which are applied world-wide, can have an enormous economic benefit, foster international trade and enable new market driven technical solutions. The best success of such international standards results when their application is voluntary. Because of their applicability IT Standards are adopted by industry and commerce.

International standards unify market requirements world-wide. This results in lower product costs and benefits users.

This benefit of international voluntary standards was recognised some 80 years ago. The International Electrotechnical Commission (IEC) was established 1906 and the foundation of the International Organisation for Standardisation (ISO) took place on February 23, 1947. The telecommunications sector is covered by CCITT and CCIR which are the Consultative Committees of the intergovernmental International Telecommunication Union (ITU) founded 1865 and since 1947 a specialised agency of the United Nations. The CCITT and CCIR-Recommendations were up to now not completely voluntary as the national telecommunications administrations use them as regulations. However, due to the increase of innovation and competition also in this sector, more openess and flexibility is taking place under restructuring.

ISO is comprised of 90 national standards bodies and performs its technical work in 2,651 technical bodies, which include about 300 decision making Technical Committees (TC). It has published 8,370 ISO-Standards, of which 240 were edited in the first half of 1992.

IEC, responsible for international electrotechnical standards, is comprised of 44 national standards bodies and performs its technical work in more than 200 technical committees including subcommittees plus additional working groups. It has published 3,400 IEC-Standards (with about 68,000 pages) 266 of which were edited in 1991.

Information Technology as an interdisciplinary sector was standardised in the 1970 in both IEC and ISO. Then in 1987 ISO and IEC formed a joint activity by establishing the ISO/IEC Joint Committee 1 (JTC1). JTC1 is comprised of 18 subcommittees, 89 working groups and special working groups and a special group on functional standardisation (see Table 1). It is responsible for more than 900 projects, with approximately 300 published standards, 150 Draft International Standards, 250 Committee Drafts and close to 320 Working Group Drafts. In 1992 there was a total of 320 international IT standards published, most of them developed by JTC1. These standards contain a total of approximately 35,000 pages of technical information. In 1992 JTC1 published almost 30% of the total international standards output of ISO and IEC. The average project-duration (from the proposal of a new work item to the finalised ISO/IEC Standard) is with 45 months 25% shorter than in ISO.

JTC1 has established a strategic planning group in order to handle the enormous demand for IT-Standards in a market driven and future oriented way. The latest established JTC1 Subcommittees mirror the present requests for future standardised solutions in the field of IT Security Techniques and the Coded Representation of Picture, Audio and Multimedia/Hypermedia Information.

To speed up the standardisation process, JTC1 has a large number of liaisons with other organisations e. g. ECMA, IEEE, SPAG, COS, EWOS, AOW, etc. With CCITT collaborative procedures are established resulting in fruitful cooperation and common standards in many fields. Also Standards Conformity Assessment,

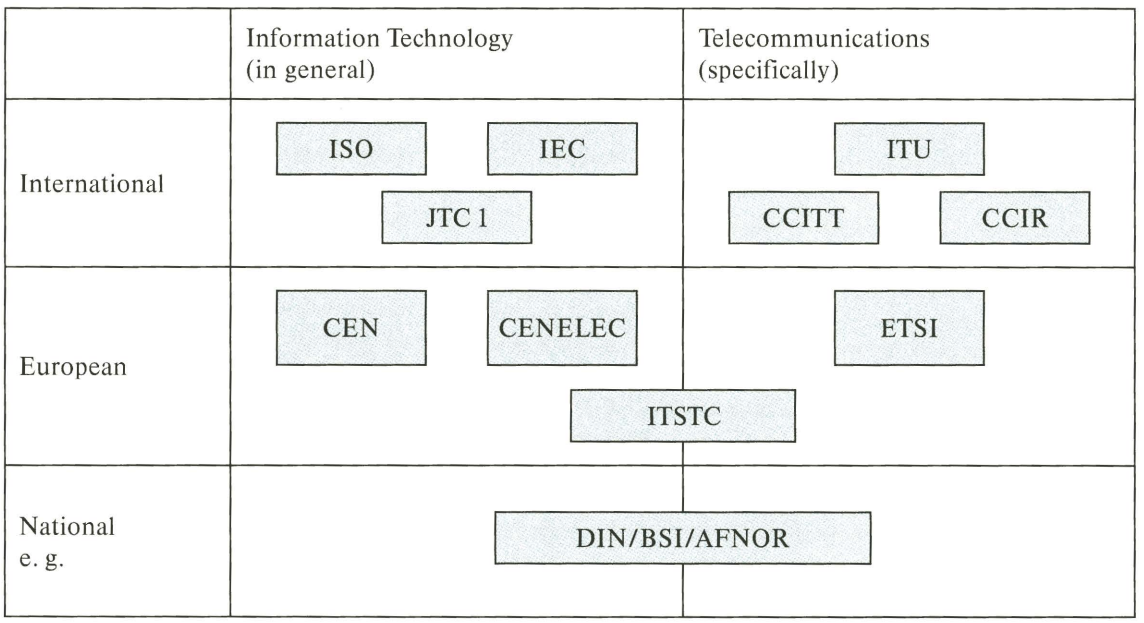


Figure 2
Standardisation Bodies Involved with Information Technology

Source: VDMA

besides test specifications, has become an important JTC1 issue resulting in an intensive dialogue with ISO's Conformity Assessment Committee (CASCO).

For the structure of international IT Standardisation and its corresponding European and national organisations see *Figure 2*. The structure of ISO/IEC JTC1 is shown in *Figure 3*.

The impact of proprietary solutions and patents on standards has been handled in the past in such a practical manner that Intellectual Property Rights (IPR) owners or the patent holders have been encouraged to have their solutions promoted via standardisation by granting licences on a fair, reasonable and non-discriminatory basis. This generally applied ISO/IEC Patent Policy has become widespread in Information Technology as an efficient and practicable procedure.

Information Technology (IT) standards are developed today in a complex, interactive system of non-intergovernmental national, regional and international organisations. Professional societies also play a strong role and there is cooperation with the treaty organisations developing the telecommunications standards also necessary for IT.

While the issues involved in IT standardisation are highly technical they are also often highly political and of both short and long range strategic significance to producers, users and governments. Accordingly, executive understanding of standards issues is essential as otherwise significant economic benefits can be lost and costly and even catastrophic mistakes made.

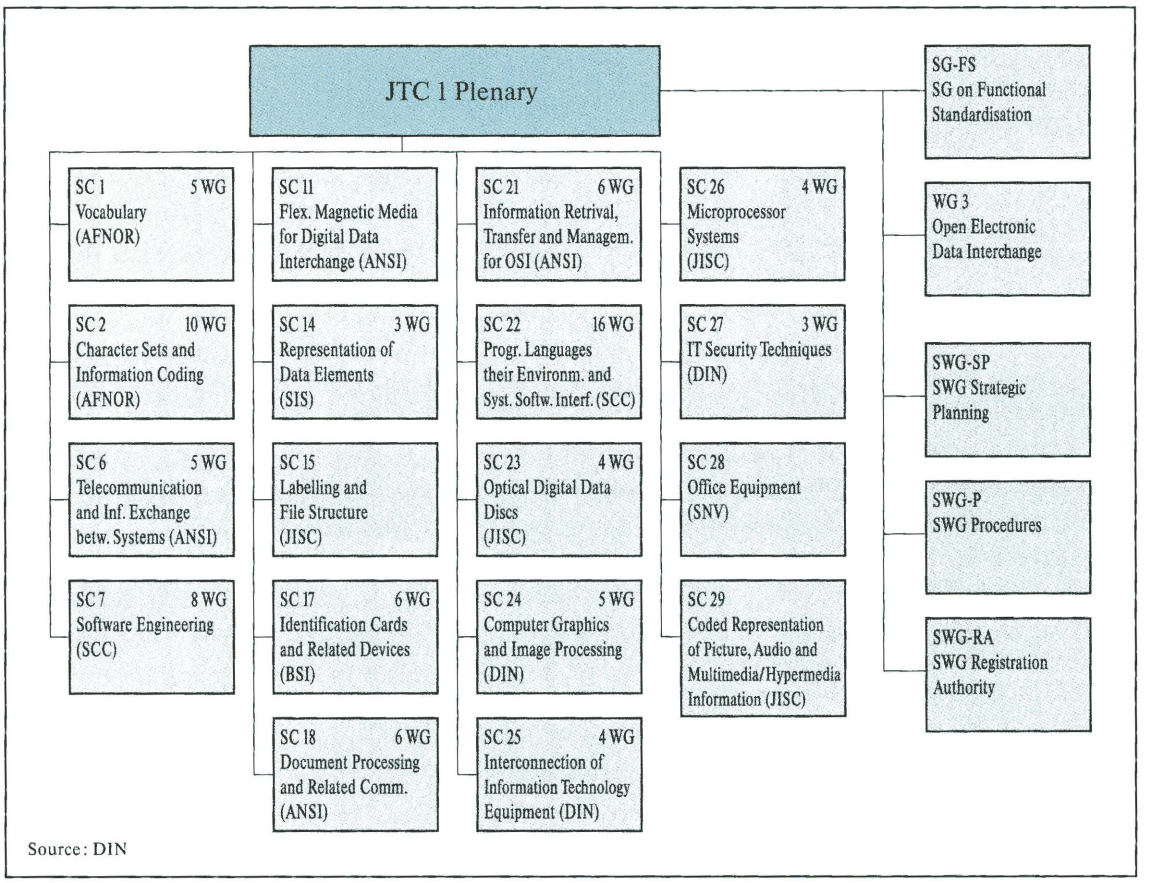
Unfortunately, the international standards arena is so rife with acronyms that attention to the subject is often quickly lost. Appendix A7 contains some technical and organisational acronyms for the reader's convenience.

3. European Standards and their Role within Community Legislation

The free exchange of goods and services in Europe was one of the essential objectives of the Treaty of Rome, which started the important process of forming a European Economic Community. To achieve this task, all legal and non-tariff or technical obstacles had to be removed within the Member States. For technical specifications, having the status of (binding) regulations or voluntary standards, this required a harmonisation process.

In the beginning of the European Community (EC) the Commission harmonised the technical details within an EC-Council Directive. To ease this task, the Council Directive on an Information Procedure in the Sector of Standards and Technical Regulations was adopted on March 28, 1983 (83/189/EEC). Accordingly a system for transparency and harmonisation of national, technical and legal regulations as well as a framework for improvement and acceleration of European standardisation was established.

Figure 3
The Structure of ISO/IEC JTC 1



Source: DIN

However, the approach of stating technically detailed requirements within the EC-Directive was not continued due to the increasing amount of technical requirements necessary to meet the essential safety requirements harmonisation requested in Art. 100a of the European Economic Community Treaty. Also the agreed time frame for the finalisation of the internal market in Europe by 1992 required a new approach. This new approach in the sector of technical harmonisation and standards to achieve the abolition of technical barriers to trade was approved on May 07, 1985 by a Council Resolution with the following key points:

- The approximation of the laws of the Member States is focussed on the essential requirements in the EC-Council Directive.
- The European Standards Organisations (CEN, CENELEC and later also ETSI) are assigned to develop the necessary technical specifications within European Standards to meet the essential requirements.
- The implementation of European standards remains voluntary. However, in case a manufacturer deviates from these standards he has to prove that their essential requirements are met.

Another supporting step was the Council Decision of December 22, 1986 on standardisation in the field of Information Technology and Telecommunications. Here a clear priority to implement international standards – when clear specifications are included – was given. Also public procurement for IT products was clearly contingent on the conformity to the European standards.

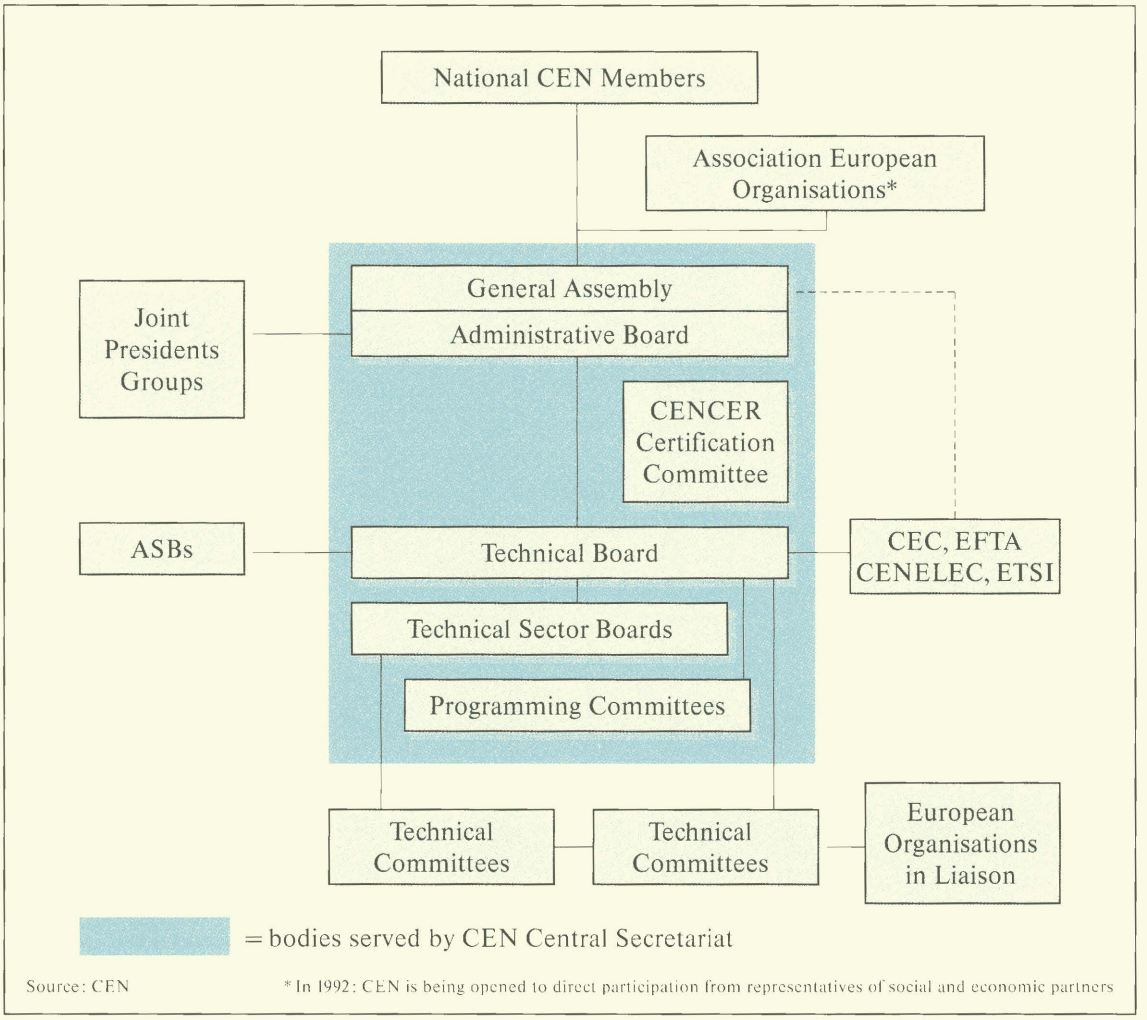
In the Information Technology (IT) sector a Senior Official Group for IT Standardisation (SOGITS) and in the telecommunications sector the Senior Official Group for Telecommunications (SOGT) was established to assist the Commission of the European Communities (CEC) to indicate which IT-Standards are to be developed. In this case the Commission will support the creation of the relevant Standards by mandates or project team fundings.

The European Standardisation Organisations (CEN, CENELEC and at that time CEPT) did agree to implement European standards as national standards via their members and the national standard institutes. By this procedure in the EC-Member States, identical standards are published and opposing specifications withdrawn. This is the common technical basis to enforce and apply the implemented EC-Directives as laws of the Member States in a uniform way. This demonstrates the significance of standards as an important aid to contribute economical and political benefit to society.

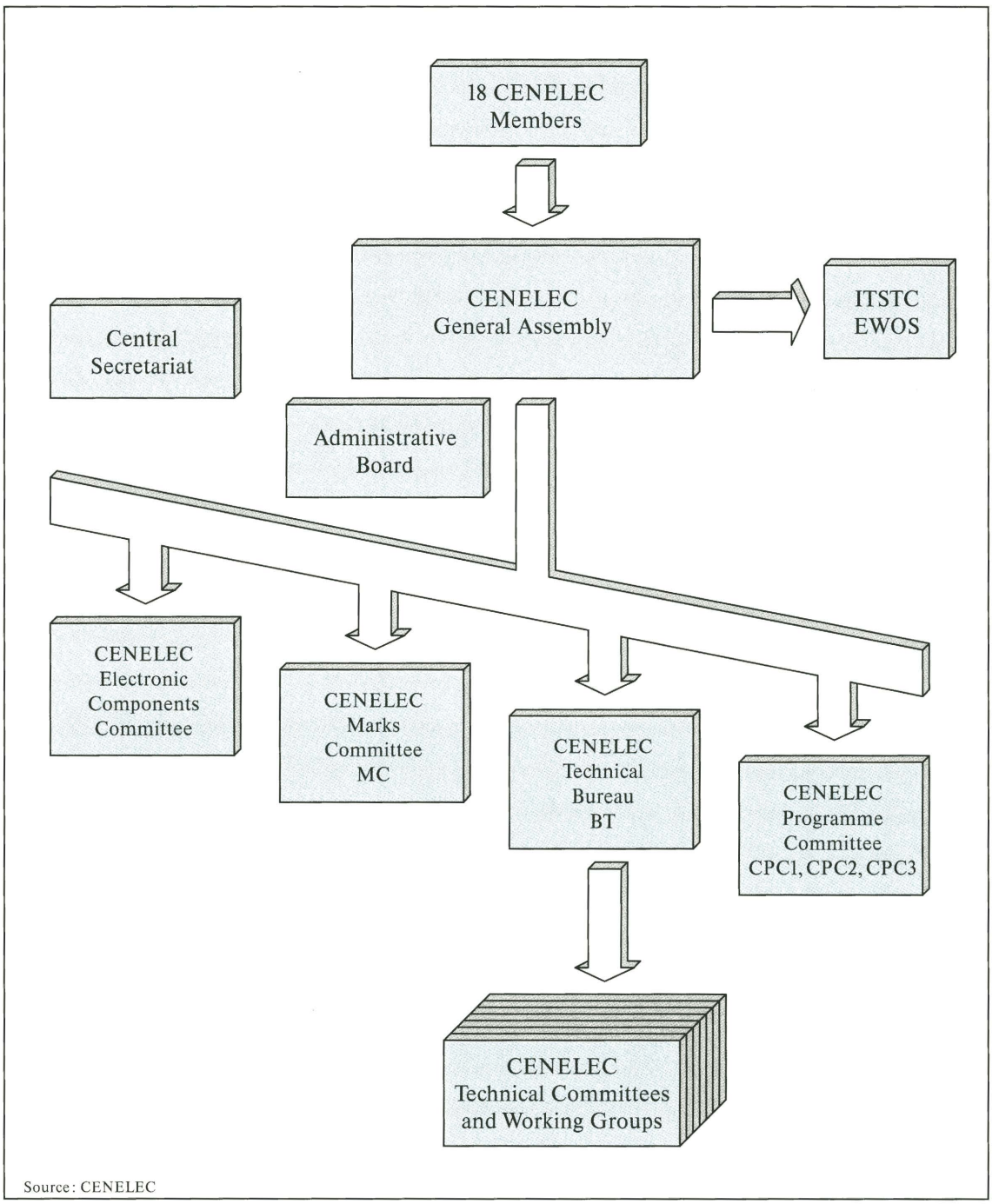
4. The European Standards Organisations CEN, CENELEC and ETSI

CEN (Comité Européen de Normalisation) is the European organisation responsible for planning, drafting and adopting European Standards as a technical basis for a functioning internal market. CEN was founded in 1957 and has 18 national member organisations (EC and EFTA) plus 7 affiliates. In its 251 active technical committees more than 600 European Standards (EN) and 50 pre-standards (ENV) have been developed up to 1992. 40% of these standards are based on, or identical to, international (ISO/IEC) standards. In the CEN sector Information Technology this percentage is far higher due to its global market orientation. CEN's field of activity covers the whole technical sector except electrotechnical (CENELEC) and telecommunications (ETSI) issues. The main fields of work are mechanical, building products, medical, aerospace, information technology, environment and transport/energy/water. For the structure of CEN see *Figure 4.*

Figure 4
The Structure of CEN



CENELEC (Comité Européen de Normalisation Electrotechnique) is the European Organisation responsible for the electrotechnical standardisation and was established in 1959 as CENELCOM. CENELEC has 18 national member organisations (EC and EFTA) plus 5 affiliated national committees. In its 67 Technical Committees 240 European Standards (EN) and 630 Harmonisation Documents (HD) have been developed until 1992. 72% of these European electrotechnical specifications are identical with international (IEC) Standards and another 17% are based on IEC Standards. The main fields of the CENELEC work include electrical safety of all electrotechnical products for domestic and industrial use, electromagnetic compatibility (EMC), electrotechnical product specifications, electrotechnical quality/performance Standards e. g. for cables, insulators, components and radio receiving and transmitting equipment. For the structure of CENELEC see *Figure 5*.



Source: CENELEC

Figure 5
CENELEC
General Structure

ETSI (European Telecommunications Standards Institute) is the European organisation responsible for telecommunications standardisation and was established in 1988 in response to the Green Paper on the development of telecommunications in Europe published by the Commission. In the field of standardisation it is the successor of the European Conference of Post and Telecommunications Administrations (CEPT). ETSI has more than 300 individual members consisting of PTT administrations, telecommunications operators (network providers), manufacturers, users, etc. and about 50 observers (e. g. associations). Until 1992 140 European Telecommunications Standards (ETS) or Interim Standards (I-ETS) and 50 European Telecommunications Reports (ETR) have been published. Part of them are based on international (CCITT or CCIR) telecommunications recommendations. ETSI's technical work is performed in the Technical Committees Advanced Testing Methods (ATM), Business Telecommunications (BT), Equipment Engineering (EE), Special Mobile Group (SMG), Human Factors (HF), Network Aspects (NA), Paging Systems (PS), Radio Equipment Systems (RES), Satellite Earth Stations (SES), Signalling, Protocols and Switching (SPS), Terminal Equipment (TE) and Transmission and Multiplexing (TM). For the structure of ETSI see *Figure 6.*

The European standardisation organisations CEN and CENELEC have a federation structure, wherein national organisations control and delegate the activities. ETSI is a direct member controlled organisation with a membership fee related to voting rights. Financing and voting are divided into one third for the administrations, one third for the telecommunications operators and one third for the manufacturers. National voting as in CEN and CENELEC is applied only in technical standardisation matters.

Another specific procedure, which was introduced when ETSI started the standardisation process, is the establishment of project teams (PT). These project teams consisting of special experts for a specified task, are financed by ETSI's costed work program to speed up the standards development process. In some cases individual members or quite often the EC-Commission finance the project teams by the voluntary work program. ETSI sets up a work program with clear deadlines and budget provisions while CEN and CENELEC prefer the bottom-top working procedures where the experts and the national standards institutes define priorities. However, ETSI is not only concentrating on voluntary standards but develops also the Technical Bases for Regulation (TBR) which the EC-Commission then converts into legally binding Common Technical Regulations (CTRs).

Meanwhile the three organisations have organised and coordinated their activities so as to cooperate in a fruitful manner. The Joint Presidents Group is convening regularly to optimise cooperation between CEN, CENELEC and ETSI. To harmonise further on an international basis CEN and CENELEC have approved the Vienna Agreement in 1991. This envisages enhanced cooperation between CEN and ISO and between CENELEC and IEC especially on standards drafting and parallel approval (parallel voting) on international and European standards.

5. The Commission's Green Paper on the Development of European Standardisation

The Commission of the European Communities has a strong interest in the European standardisation process and organisations (see Chapter 2).

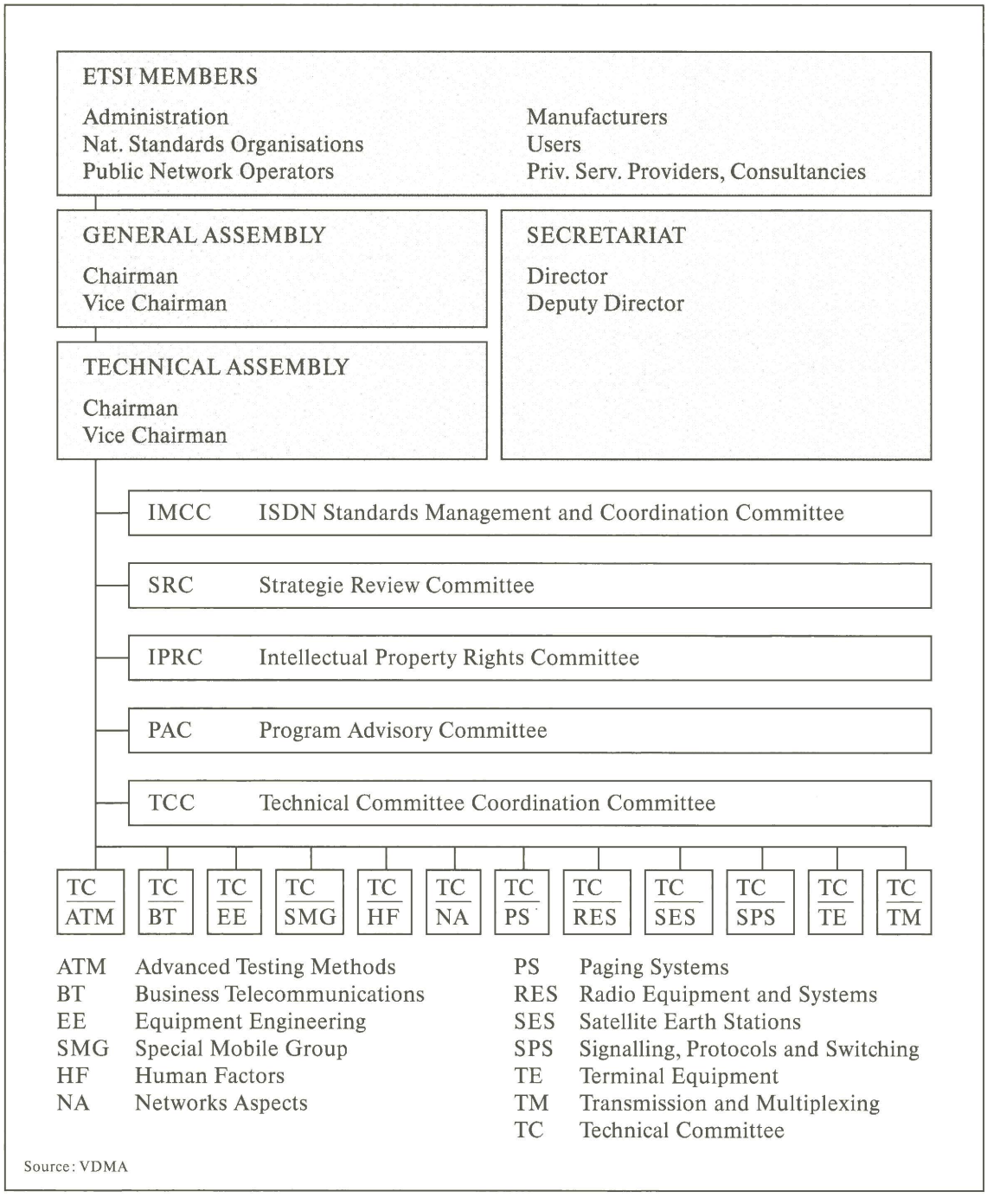


Figure 6
The Structure of ETSI

A Green Paper on the Development of the European standardisation was launched on January 28, 1991 by the Commission. In the Green Paper strong centralisation was proposed with the objective of improving efficiency. Also strong involvement of the Commission was envisaged. To speed up the process and reach greater flexibility another key point was to support the project team procedure (of ETSI) with private consultants drafting standards. Also direct European participation in one working language in a large European Standards Organisation was suggested with financing to be provided by the interested groups (except payments by users). A large number of comments have been received on the Green Paper and on June 18, 1992 the resulting Council Resolution on the Role of the European standardisation in the European Economy was published. In this resolution the following key points are emphasised:

- General importance of a coherent European standardisation system which is transparent, open, consensus-based, efficient and supported by all parties concerned without being dependent on single interests.
- Standards must remain voluntary although they are subject to public interest.
- International standards are beneficial when internationally applied. They should be taken over as European Standards when they meet European demands.
- Quality and applicability of standards is a major requirement and equivalent to timely and up-to-date standards.
- Clear standard requirements with uniformly applied test specifications must be available in all European Member States, so that the European Directives and Regulations can be practiced.
- The standardisation process should take increasing account of small and medium size companies as well as of users.
- The European Standards Organisations shall be supported in improving efficiency and speed. The European Commission as well as the national governments are requested to contribute and provide financial support.
- An European Standard Conformity Mark shall be promoted by the Commission and the European standards organisations.

6. Conformity to Standards – the European Approach

The European Community (EC) requests harmonisation of binding regulations and voluntary Standards to abolish technical barriers to trade and facilitate the development of the internal market (see Chapter 2).

This harmonisation is performed by the Commission of the European Communities (CEC) and approved by the Council of the adequate European Ministers, when legally binding Directives are concerned. The harmonisation of Standards is performed by the European Standardisation Organisations. However, only compliance to the Regulations and Standards can finally create the confidence which allows Europewide exchange of IT products without further control.

The unconditional prerequisite for assigning a standard conformity statement is testing. These tests are in general performed during the development and manufacturing processes. These first party tests at the manufacturers premises are commonly used with complex products and systems such as typical within the Information Technology. One test of the finalised product is sufficient only with simple products.

In the past some producers had their test activities outsourced to "third party test" institutes, especially when one final test at the end product could deliver an adequate assessment. Some of

the users also control the standards conformity in a kind of incoming product control as so-called "second party tests".

As the testing against harmonised test specifications in standards is a complex process and should be transparent and understandable for the user, the European Standards Series EN 45000 was published. It specifies the requirements for operation, assessment of test laboratories, certification and accreditation bodies as well as for the Supplier's Declaration of Conformity. Also the European Associations of Information Technology Industry (EUROBIT) and the one for Telecommunications Industry (ECTEL) have published a well approved brochure in which the Declaration of Conformity by the Supplier and the Third Party Certificate as equivalent options to the market place are highlighted. In this brochure the practical process of the alternatives to declare conformity (see *Figure 7),* and a realistic example for a Supplier's Declaration are described. European information technology makes use of both, the Supplier's Declaration of Conformity as well as the Certificate. In cases of highly complex products, distributed development and manufacturing centers (e. g. in different countries) as well as fast responses to highly competitive market only the manufacturer's comprehensive test facilities including continuous testing and monitoring can do the job in time at reasonable expense. However, there is a market for third party testing because smaller organisations need it as well as sometime larger ones.

To build up confidence in testing operations and results, the EN 45000 Series provides the process of accreditation and certification. First party (manufacturers), second party (customers) and third party (private/public) laboratories can be accredited against clear, formal and technical capability specifications. Certification is performed by an independent organisation which assignes a Certificate to the test report of the accredited test laboratory, if applied and paid for.

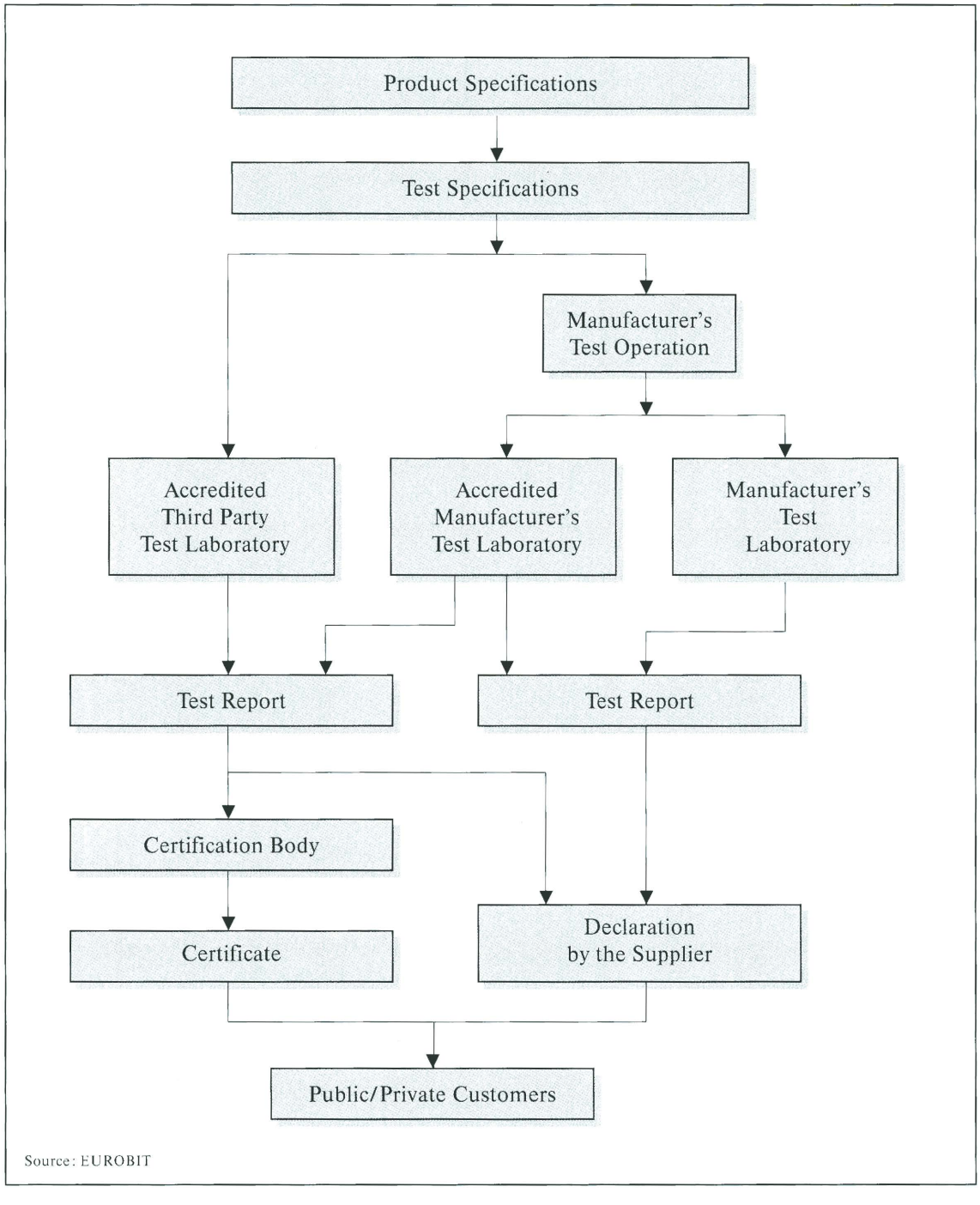
As conformity to standards is the technical basis to conformance with the binding EC-Directives, the Commission is strongly involved in this issue and has published the Council Decision in which the "Global Approach on Testing and Certfication" is included. This Global Approach contains 8 Modules with Module A as the Supplier's Declaration and Module H as full Quality Assurance under the responsibility of the manufacturer. The other Modules involve third party laboratories and institutes as well as monitoring processes. A certified Quality Management System according to EN 29001 includes also the possibility for standards conformity test activities and accordingly covers the prerequisites for issuing a conformity statement.

The Global Approach deals with standards conformity but aims at conformity with the essential requirements of the EC-Directives. This conformity is indicated by the CE-Mark which the manufacturer affixes to his product. The intent of the CE-Mark is that products with CE-Marks can be placed on the market Europe-wide without any restrictions unless, of course, there has been malpractice.

With the support of the EC-Commission the European Organisation for Testing and Certification (EOTC) was established in 1990 to build up a formal system for the conformity testing with sector organisations for all technical fields.

Here Information Technology gave rise to in the first sector organisation, the European Committee for IT Testing and Certification (ECITC) which runs a number of specific agreement groups for certain test areas e. g. Electromagnetic Compatibility (EMC), Open Systems Interconnection (OSI). ECITC has in the EC Member States Mirror Committees e. g. DEKITZ in Germany which perform the functional business especially in accreditation of test laboratories.

Figure 7
Alternate Paths to Conformity Declaration



Source: EUROBIT

Already in 1985 the EC-Commission launched the Conformity Testing System (CTS) initiative with the following principles:

- There should be one set of tests for any given technical area throughout Europe, and those tests should be internationally standardised.
- There should be a common technical authority for a given set of tests.
- The procedures and documentation (especially test reports) should be the same in all cases.
- Every test should be made available regardless of the country of origin of the product.
- The service should be made available regardless of the country of origin of the product.
- There should be mutual recognition of test results between countries, at least within Europe and preferably wider. A product tested in one country should be accepted without retesting in another country.
- There should be competition in the provision of testing services.
- The tests should be grouped according to the needs of the buyer and the supplier as well as the user.
- Such multi-standard testing services should cover the Euroepan functional standards (EN or ENV) and the international standards referenced therein.
- The testing services should become financially autonomous.
- Test centres should have sufficient independence to function as third-party test laboratories.

After CTS1 of 1985 the second phase CTS2 was started in 1988 widening the scope from originally OSI Testing. The CTS program was supported with 30 Mio. ECU. Gradually the CTS will have to become financially independent. CTS has made considerable progress with the support of the EC-Commission during the last years.

7. Standards and Intellectual Property Rights

Today much of the development of international information technology standards is being derived from the research and development efforts of companies as opposed to documenting proven experience. This means that intellectual property rights and, in particular, patents, have increasingly become a significant factor in standardisation. ISO and IEC have both adopted policies with regard to patents which recognise that standards have little value if there are restrictions concerning their application. Accordingly they require that if a standard contains provisions which involve the use of patented items, the patent holder must agree that licences will be granted under reasonable terms and conditions and on a non-discriminatory basis. This policy has been found effective in promoting market enhancing standardisation and at the same time protecting intellectual property rights in accord with international conventions.

CCITT also follows in principle the same patent policy in the international telecommunications sector as ISO and IEC. In European telecommunications standardisation a more detailed and complex approach is under discussion. ETSI has taken the lead to develop a system which shall balance the proprietory aspects of substantial investments in R & D with the public interest. This approach will include some additional efforts for patent search investigations of the involved parties such as patent owners and standards institutes. It represents a great challenge to balance complex laws with the public interest in the fast moving field of high-tech development in IT.

Table 1
Glossary

ANSI	American National Standards Institute
AFNOR	Association Française de Normalisation (French Standards Institute)
BSI	British Standards Institution
CCIR	Comité Consultatif International des Radio-Communications (International Radiocommunications Consultative Committee)
CCITT	Comité Consultatif International Télégraphique et Téléphonique (International Telegraph and Telephone Consultative Committee)
CEC	Commission of the European Communities
CEN	Comité Européen de Normalisation (European Committee for Standardisation)
CENELEC	Comité Européen de Normalisation Electrotechnique (European Committee for Electrotechnical Standardisation)
CEPT	Conference Européenne des Administrations des Postes et des Télécommunications (European Conference of Postal and Telecommunications Administrations)
COSINE	Cooperation for Open Systems Interconnection Networking in Europe
CTS	Conformance testing services
DIN	Deutsches Institut für Normung (German Standards Institute)
EC	European Community, comprising the European Economic Community, the European Coal and Steel Community, and Euratom (European Atomic Energy Community)
ECMA	European Computer Manufacturers' Association
ECITC	European Committee for IT and T Testing and Certification
ECTEL	European Telecommunications and Professional Electronics Industry
EDIFACT	Electronic Data Interchange for Administration Commerce and Transparence
EMUG	European MAP (Manufacturing Automation Protocol) Users' Group
ETSI	European Telecommunications Standards Institute
EUROBIT	European Association of Manufacturers of Business Machines and Information Technology Industry
EWOS	European Workshop for Open Systems
FTAM	File transfer Access and Management
IEEE	Institute of Electrical and Electronic Engineers (New York)
IEC	International Electrotechnical Commission
ISDN	Integrated Services Digital Network
ISO	International Organisation for Standardisation
IT	Information Technology
ITU	International Telecommunications Union
ITSTC	IT Steering Committee
JISC	Japanese Industrial Standards Committee
JTC 1	Joint Technical Committee 1 of IEC and ISO
LAN	Local Area Network
MHS	Message Handling Systems
NET	Norme Européenne de Télé-communications (approved technical specification of CEPT)
NIST	National Institute of Standards and Technology (USA)
ODA	Office Document Architecture
OSITOP	Open Systems Interconnection/ Technical and Office Protocol
PSDN	Packet Switched Data Network
RARE	Reseaux Associés pour la Recherche Européenne
SOGITS	Senior Officials Group of IT Standardisation
SOGT	Senior Officials Group on Telecommunications
TEDIS	Trade Electronic Data Interchange Systems
WAN	Wide Area Network

Part Two

The European Software and Services Marketplace

1. Introduction

Europe represents the largest software and services market in the world (worth 53 billion ECUs in 1992). Its expansion has been remarkable, not only in terms of speed but also in terms of the very specific development models adopted by individual countries.

However, because of its advanced state of development, the European market has become more sensitive to its macro-economic environment, and some segments (e. g. multi-user systems) have been particularly affected by the general slowing down of the world IT market as a whole. This has led to considerable changes in market organisation and business models, allowing Europe to perform no worse than even historically more buoyant areas (such as Japan) which have lost some of their dynamism.

The present analysis aims at assessing the European software and services market in terms of competition, user purchasing attitudes and market potential.

It offers an overall assessment of the quantitative trends of the European market at a segment and sub-segment level, and the way in which these relate to the offering mix of products and services (e. g. CASE, distributed computing and the emergence of middleware).

The major competitive directions of the European software and services industry are analysed by considering the breakthrough of hardware vendors as major influencers of the market, the growing importance of US companies in planning and management services, and the way in which mergers and acquisitions are affecting the industry's organisation.

A detailed description of the evolution of IS spending in Europe allows an assessment to be made of the trends among major European users in terms of new technologies and standards (client/server computing, open systems and LANs), and the shift towards external services (outsourcing, systems integration and network management).

The peculiarities and specific trends of Europe's major geographical markets (Germany, France, the UK and Italy) are examined in detail.

Finally, the future of the industry is considered in the light of ongoing European economic integration and the emerging behavioural patterns of users and major players - the main factors which will influence the development of the strategies underlying the European software and services market throughout the 1990's.

2. Market Trends

The European software and services market was worth 53 billion ECUs in 1992, or some 42% of the total IT market. If hardware maintenance and support services are included, the total share of non-hardware business increases to 53%.

Expansion has been very rapid over the last few years, with overall market growth gaining from the different national contributions of the various business sub-segments. There has been a growth of 9% in packaged software, 8% in professional services, 5% in processing services and 16% in network services.

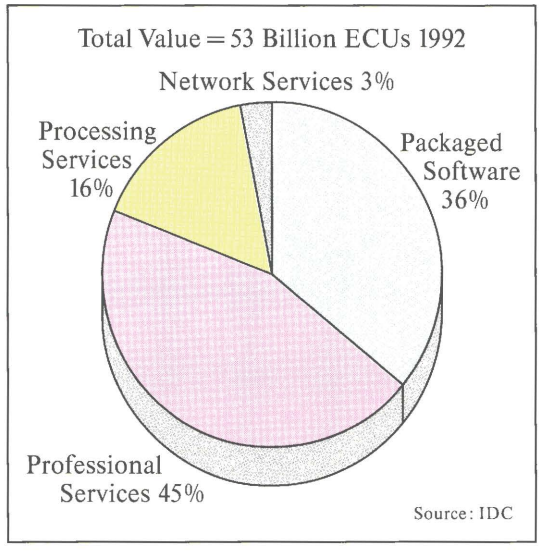
Table 1
Western European (*) Software and Services Market by Major Product Category (**). Billion ECUs (***)

	1992 Value	1992 %	1994 Value	1994 %	CAGR 92-94 (****)
Packaged Software	19	36	23	36	9.0%
Professional Services	24	45	28	45	8.2%
Processing Services	9	16	10	15	5.2%
Network Services	1	3	2	3	16.1%
Total	53	100	62	100	8.2%

Note: (*) Western Europe = EC (excluding Greece, Portugal, and Ireland) + EFTA
(**) For product segment definitions and classifications, please refer to the "Definitions" at the end of the Statistical Section.
(***) Values have been rounded to billions of ECUs at 1991 constant exchange rates. Totals and percentages may not add up due to rounding.
(****) CAGR = Compound Annual Growth Rate

Source: IDC

Figure 1
Western European Software and Services Marketplace by Product Category



Greater dynamism in the evolution of the software and services market (in comparison with the other IT market segments) is expected to lead to an increase in its share of overall IT business. This process should be further accentuated by the negative effect that price erosion will have on growth in the value of the hardware segment.

Table 2
Software and Services as a Proportion of IT Market in Western Europe

	1992	1994
Packaged Software	15%	16%
Professional Services	19%	20%
Processing Services	7%	7%
Networking Services	1%	1%
Maintenance Services	11%	10%
Hardware	47%	45%

Source: IDC

2.1. Market Dynamics by Product/Service

In order to understand the size and differences in growth of the various product segments, it is necessary to make detailed comparisons across segments and sub-segments.

2.1.1. Packaged Software

In 1992, the value of the packaged software segment reached 19 billion ECUs, and now represents some 36% of the software and services market.

The segment can be looked at from both the platform and products viewpoints.

Platforms

Most of the growth in the segment was generated by PC and, to a lesser extent, Unix software. This was partially offset by poorer performances in some areas of multi-user software and, particularly, large-scale systems software (which was affected by the negative market performance of hardware).

The most dynamic growth occurred in *single-user software* products. This was supported by a number of key trends in the computer market, particularly the development of distributed computing (which benefitted from the clear trend towards networking). Distributed computing allows end-users to make greater use of information technology, speeds up the migration of applications from centralised to end-user systems, and consequently leads to an increase in the demand for single-user processing power and applications.

The current success of *Unix-based software* products is due to the spread of Unix-based open systems. The European Unix-based software market is expected to be worth almost 5 billion ECUs by 1994, when it should account for more than 20% of the packaged software market.

Products

The European *application tools market* accounted for almost 6 billion ECUs in 1992. Although it is largely dominated by US vendors, European companies have recorded a number of worldwide successes. The market is expected to grow by some 9.6% per year between 1992 and 1994, by which time it should be worth 7 billion ECUs.

Continued penetration of Relational Database Management Systems (RDBMS) and the associated database tools, as well as of independent 4GLs, should account for most of the expected growth in the tools market, because there is still a significant demand potential for the replacement of flatfile applications with applications based on relational data structures. As PCs rapidly replace terminals, Graphical User Interfaces will sustain growth in the 3GL and utilities areas, because MIS will need tools to improve interface, navigation, and information access without completely re-engineering applications. In the longer term, it is believed that tools aimed at facilitating the implementation of client/server applications will fuel the growth of the application solutions market; multimedia tools will probably be slower in becoming key market drivers.

	1992 Value	1992 %	1994 Value	1994 %	CAGR 92-94
Single-user	3	16	4	18	16.4%
Small-scale	6	31	7	32	10.5%
Medium-scale	6	34	7	33	7.5%
Large-scale	4	19	4	16	1.4%
Total	19	100	23	100	9.1%

Source: IDC

Table 3
Western European Packaged Software Market by Platform. Billion ECUs

The *application solutions market* is expected to grow by 10.4% per year between 1992 and 1994, when it will be worth 10 billion ECUs (the term "application solutions" only refers to commercially available standard products. Bespoke custom software is included under "contract programming" in the section on professional services). The bulk of the market will be increasingly represented by a basic demand for PC-operable solutions capable of combining personal productivity applications such as spreadsheets, databases and word processing. Although taking off more slowly, demand for integrated office systems will contribute towards this trend. A new wave of client/server solutions will begin replacing host-based applications; this will generate more sustained market growth although, given the complexity of building the applications and the organisational changes required for implementing such architectures, the process of migration will certainly be gradual.

Table 4
Western European Packaged Software Market by Application
Billion ECUs

	1992	1994	CAGR 92-94
Systems software and utilities	5	6	5.9%
Application tools	6	7	9.6%
Application solutions	8	10	10.4%
Total	19	23	9.0%

Source: IDC

The *systems software and utilities* market was worth 5 billion ECUs in 1992 (representing 27% of the total packaged software market). The bulk of this market is accounted for by operating systems (about 49%), followed by Data Center Management Software (41%) and utilities (10%). This market segment is expected to grow by 5.9% per year between 1992 and 1994, when it should be worth almost 6 billion ECUs. In comparison with the other application areas, this will mean a decline in its business share. The dynamics of this sub-segment are very dependent on the market of large-scale systems and, despite some major technological innovations (aimed, for example, at proposing more products for monitoring system efficiency). This sub-segment will be negatively affected by the trend towards downsizing. Although its growth performance will be comparatively lower, the systems software and utilities market will be characterised by a certain stability because the demand for mainframe and minicomputer operating systems and lower prices for open operating systems will continue to erode the large-scale systems software business (the largest segment of the systems software and utilities market).

However, the process of creating PC local area networks and the integration of LANs and other systems into a centrally managed enterprise-computing resource represents a challenge for software vendors. There will be increasing user demand for the remote (and therefore automated) management of such heterogeneous enterprise networks and, secondly, the development of more complex applications and tools will ultimately lead to a significant demand for middleware - the enabling technology that isolates application functions from hardware and software platforms.

Strategically, the applications market is becoming more important as users tend to shift their emphasis towards obtaining greater control over the management of their DP resources and more optimised use of their hardware base.

Penetration of Non-European Vendors

As explained in Part One, The Current IT Situation and Perspectives, some segments of the software business are showing clear signs of globalisation. This is especially true in the systems software and utilities business, where the influence of the global activities of traditional systems providers is stronger. It is therefore not surprising that the European market is almost totally supplied by US providers. According to 1991 worldwide consolidated figures, US vendors represent some 87% of worldwide production, as against 41% of worldwide consumption.

The penetration of non-European vendors is less in the application software business, where the focus on vertical markets, different languages and different national requirements make it more localised. However globalised the packaged software market may be, the presence of Japanese vendors in Europe is still weak.

Worldwide, US providers have a 78% share of the software business, as against the 16% of European and the 4% of Japanese vendors. In terms of consumption, these proportions change to 40% for the US, 41% for Europe and 11% for Japan.

Region of Consumption	US	Europe	Japan	RoW	Worldwide	% of World Production
Region of Production						
US						
Tools	4.8	3.4	0.7	0.9	9.8	80%
Solutions	6.1	3.4	0.8	1.1	11.4	70%
Sys.level	5.3	4.0	0.9	1.1	11.3	87%
Total	16.2	10.8	2.4	3.1	32.5	78%
Europe						
Tools	0.1	1.7	0.1	0.0	1.9	16%
Solutions	0.2	3.6	0.1	0.0	3.9	24%
Sys.level	0.1	0.7	0.1	0.0	0.9	7%
Total	0.4	6.0	0.3	0.0	6.7	16%
Japan						
Tools	0.0	0.0	0.3	0.0	0.3	3%
Solutions	0.0	0.0	0.8	0.0	0.8	5%
Sys.level	0.0	0.1	0.6	0.0	0.8	6%
Total	0.0	0.1	1.7	0.0	1.9	4%
Rest of World						
Tools	0.1	0.1	0.0	0.0	0.2	2%
Solutions	0.0	0.1	0.0	0.0	0.2	1%
Sys.level	0.0	0.0	0.0	0.1	0.1	1%
Total	0.1	0.3	0.0	0.1	0.5	1%
Worldwide						
Tools	5.0	5.3	1.1	0.9	12.3	
Solutions	6.3	7.1	1.7	1.2	16.3	
Sys.level	5.4	4.8	1.6	1.3	13.1	
Percent of Worldwide Consumption						
Tools	41%	43%	9%	7%	100.0	
Solutions	39%	44%	10%	7%	100.0	
Sys.level	41%	36%	13%	10%	100.0	
Total	40%	41%	11%	8%	100.0	
Note: 0.0 = market size less than 100 million Totals and % may not add up due to rounding						

Source: IDC

Table 5
Total Worldwide Packaged Software Market 1991: Percentage Breakdown by Geographic Region and Type. Billion ECUs

2.1.2. Professional Services

The European professional services market grew by 9.6% in 1992, although it must be said that there were significant geographical differences between the Northern European countries most severely affected by the recession (Sweden, Finland and the UK) and the more dynamic Southern European markets (Spain and Italy).

More importantly, the economic crisis is exacerbating a shift in user demand from more traditional services (bespoke software development) towards global offers representing either a direct cost-saving alternative (facilities management) or solutions for problems concerning more general corporate management questions.

This market is characterised by a significant quantitative evolution of different kinds of services, high-end services being those which are most likely to gain in importance.

Consulting services will draw the greatest benefit from the users' shift in emphasis from basic custom software development towards services aimed at maximising the use of the information systems existing within their organisations, as well as towards services enabling them to adapt their information systems to management changes, and vice-versa (business process redesign).

The increase in IT consulting services will not only facilitate a breakaway from US consulting and audit companies, but is also a sign that the market is now at a stage where its basic development needs can be more often satisfied internally or off-shore, and that demand is concentrated on high-end, high value-added service offerings. This represents one of the most important challenges for European companies who are multiplying their efforts to stay at the forefront of this new market, and also emphasises an underlying trend towards the gradual elimination of the distinction between management issues and DP strategies.

Contract programming still accounts for the greatest share of the market, while *staff delegation* is most affected by the growing autonomy of the users.

Systems and network operations (or facilities management - FM) will also benefit from the users' increasing quest for cost-effectiveness. The growing tendency of user organisations to concentrate on their primary businesses will increasingly lead them to examine opportunities of outsourcing the management of at least part of their information systems.

Training and Education will sustain market growth, although it will be characterised by the increasing specialisation of the courses provided. On the other hand, custom software development services are feeling the impact of the increasing autonomy that more powerful tools (e. g. CASE, 4GLs) and standard products are giving to users, and packaged solutions are benefitting from their ever more flexible customisation features and their high cost/efficiency ratio. Consequently, large-sized packaged software vendors are gradually making headway among the top services providers in Europe.

In terms of competition, hardware vendors (who control some 15% of the market) will see their position strengthened as more external growth operations are made, and as their size and client portfolio enable them to support the development of investment-intensive services such as FM. US service companies will increase their market share (in the region of 16% in 1992) through mergers and acquisitions, and as a result of growing US interest in the European market. The market share of the European services industry is likely to shrink slowly but significantly, partly because of this pressure from hardware vendors and US companies, and partly because it has not yet finished its reorganisation.

Systems integration is having a positive effect on the professional services business as the fastest growing way of delivering integrated IT hardware, software and services solutions. The increasing importance of information systems to organisational management means that IT can no longer be considered a peripheral activity; the management of information systems themselves is tending to become more complex as the multiplication of mergers and divestitures leads to the creation of separate "islands" of automation.

	1992 Value	1992 %	1994 Value	1994 %	CAGR 92-94
IT Consulting	4	19	5	18	7.0%
Contract Programming	10	40	11	40	8.1%
Staff Delegation	4	16	4	15	4.9%
Education and Training	4	17	5	17	8.6%
Systems/Network Operation	2	8	3	9	16.5%
Total	24	100	28	100	8.2%

Source: IDC

2.1.3. Processing and Network Services

Processing services lag behind the overall market in terms of growth (5.4% in 1992), being structurally deprived of growth potential by the continuing relative importance of the traditional services market which is now finding its development hampered by the increasingly available computer power at users' sites.

On the other hand, network services represent a growing area of opportunity (17.1% in 1992), although they are not yet big enough to compensate for the flat performance of traditional services. Factors such as the deregulation of the European telecommunication services market (widely encouraged by the European Commission) and the outcome of pan-European projects are driving market growth, but one major hindrance is still represented by the considerable variation in the degree to which the various member states have so far liberalised their national telecommunications markets. Another fundamental development will be the multiplication of virtual private networks as the slowly growing economy continues to pressure users to cut costs. The future of the market will therefore increasingly rely on solutions mixing public and private networks and applications, and the number of joint-ventures and strategic alliances are likely to increase in this more competitive market.

Table 6
Western European Professional Services Market by Application
Billion ECUs

2.2. Market Dynamics by Country

In terms of country evolution, the picture of the European market is anything but homogeneous. The environment and dynamics of each national market are the result of a combination of specific local trends (linked to factors such as local regulations and cultural differences) and trans-national factors. Germany, Italy and Spain are the fastest growing geographical areas.

	1992 value	1992 %	1994 value	1994 %	CAGR 92-94
Germany	12	22	14	23	9.1%
France	9	17	10	16	5.0%
UK	8	16	10	16	7.2%
Italy	7	13	8	13	8.6%
Spain	2	3	2	4	14.1%
Other	15	28	18	28	9.1%
Europe	53	100	62	100	8.2%

Source: IDC

Table 7
Western European Software and Services Market by Major Countries: 1992-1994.
Billion ECUs

Table 8
Western European Packaged Software Market by Major Countries.
Billion ECUs

	1992 value	1992 %	1994 value	1994 %	CAGR 92-94
Germany	4	22	5	23	10.4%
France	3	15	3	15	6.1%
UK	3	18	4	17	5.8%
Italy	3	14	3	14	8.8%
Spain	1	5	1	5	12.2%
Other	5	26	6	27	11.2%
Europe	19	100	23	100	9.0%

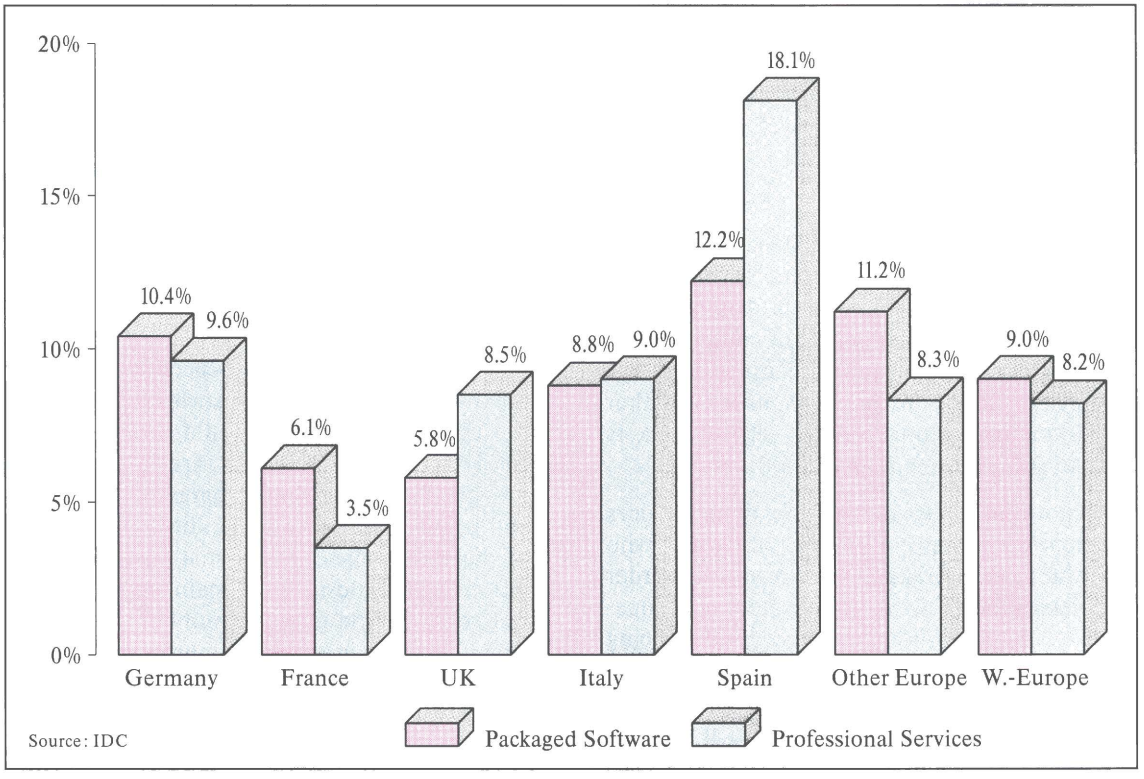
Source: IDC

Table 9
Western European Professional Services Market by Major Countries.
Billion ECUs

	1992 value	1992 %	1994 value	1994 %	CAGR 92-94
Germany	6	23	7	23	9.6%
France	5	19	5	15	3.5%
UK	3	15	4	17	8.5%
Italy	3	13	4	14	9.0%
Spain	1	3	1	5	18.1%
Other	6	26	7	27	8.3%
Europe	24	100	28	100	8.2%

Source: IDC

Figure 2
Western European Software and Services Market Compound Annual Growth by Country 1992-1994



2.2.1. Country Outlook

Germany

With a 22% share of the European software and services market (worth 12 billion ECUs and growing by some 10% per year), Germany is the largest and one of the fastest growing of all European country markets. A large number of independent software vendors with small local operations control about 86% of the business, the rest being under the control of traditional systems vendors.

Packaged software is the fastest growing segment (15.2% growth in 1992) followed by professional services (12.4%); processing services are growing much more slowly. Among the professional services, IT consulting is experiencing particularly strong growth and the German market is rapidly catching up with more consulting-intensive markets such as the UK. The same process is taking place in facilities management.

Manufacturing represents the largest vertical market for German professional services vendors (representing almost one-third of their business), but it is set for a period of comparatively low growth mainly because of competition from rapidly spreading packaged solutions. Other important professional services vertical markets are Local Government and Health.

A noticeable push in the professional services segment is coming from industrial Groups who are tending to leverage on their expertise in order to diversify their activities by developing Europe-wide business solutions - thus counterbalancing the increasing interest of foreign (especially French) vendors who have undertaken a number of external growth operations aimed at enhancing their presence in Germany.

Although reunification has had a definitely positive impact on growth, the increasingly recessionary state of the economy, as well as the effects of high interest rates, heavier taxation and depressed internal consumption, threaten to slow down the dynamics of Germany's software and services market. However, growth over the next two years will stabilise at around 10% for both professional services and packaged software (a rate that is still higher than the average anticipated for Europe), and the country will increase its share of European business to 23% in 1994.

France

The French market was worth about 9 billion ECUs in 1992. The market is performing less well than the European average, as overall perspectives are dimmed by the professional services market (some 5 billion ECUs in 1992, with an expected growth of only 3.5% over the next two years) and only partly compensated for by the dynamism of the packaged software segment (3 billion ECUs in 1992, and an anticipated growth of 6.1% up to 1994).

In general, short term perspectives are very much dependent upon general macro-economic performances.

With poor economic prospects as a result of flat internal demand, the French market reflects the consequences of its rapid reorganisation. Local large-sized vendors are under heavy pressure from increasingly aggressive US players and trying to adapt to lower local growth rates by means of policies of internationalisation and rationalisation designed to maintain their financial security. The growing number of alliances currently being forged are aimed at creating and exploiting synergies to complement their product and service offers.

On the packaged software side, US vendors are constantly deepening their penetration as a result of the expansion of desktop computing and Unix-based systems.

The expected period of slower growth in the professional services market reflects a certain level of development and the increasing tendency of users to make use of packaged solutions and more advanced development technologies (CASE, 4GL). IT consulting services have also reached an advanced stage of development, and there is increasing competition between local independent software vendors and large-sized US consulting firms. On the other hand, training and education will become a more important market as users find themselves faced with new types of computing (distributed processing and networks) and higher levels of staff turnover.

As in Germany, the facilities management market is expected to grow rapidly and begin to catch up with more mature country markets.

Local companies are developing towards the supply of higher added-value services (management consultancy and integration services as sub-contractors for large projects), less importance being given to basic staff delegation activities.

United Kingdom

Worth more than 8 billion ECUs, the UK software and services market is the third largest in Europe. It has been greatly affected by the economic recession since 1991, although 1992 did witness a slight recovery in terms of an 11% increase which was due more to professional services (up 12.7%) than packaged software (up 10.9%).

The packaged software market is more highly developed than in other countries since, for cultural and linguistic reasons, user organisations integrated software products earlier than elsewhere. The availability of a wide range of US software products emphasised this trend, which also favoured the UK packaged software industry in obtaining a fairly successful position in international markets. Although users still prefer packages for traditional horizontal applications, they privilege customised solutions for their own specific problems and for the core applications that provide a greater competitive edge and better services for their customers.

The prospects for the development of application solutions depends to a large extent on the widening gap between custom and packaged software. Integrated packages still only partially meet users' requirements, leaving room for the development of the customisation of basic packaged procedures to specific company procedures. As a consequence, there is likely to be a trend towards verticalisation with the offer mixes of packaged solution vendors and professional service providers competing on the same ground.

IT consulting and contract programming have performed better than the other professional services, while the previously highly successful systems and network operations (facilities management) segment is experiencing a period of slower growth. The UK facilities management business is the largest in Europe, and its growth rate is expected to be in the region of 15.2% for the next two years. The market environment is showing signs of tension as users place increasing emphasis on project management competences, become more price-sensitive, and pay more attention to contractual guarantees. Although the number of orders shows no signs of diminishing, prices are decreasing, and this is putting pressure on the profitability of the main FM service providers.

UK players have also developed a particularly strong competitive image in the area of network services.

The structure of the UK services industry is characterised by a high degree of concentration, with the top 15 service vendors controlling some

43% of the professional services market. This is coupled with a high degree of penetration on the part of a number of large-sized foreign (especially US) software houses, who have managed to take over a large number of UK vendors. Another important characteristic is the existence of a range of dynamic medium to large-sized companies who are emerging as alternative service sources with a high level of expertise.

Italy

Italy is currently confronted by a rigorous national economic policy; business grew some 10.9% in 1992 (down from 14.9% in 1991). Although the software and services market is expected to grow at a comparatively high rate (8.8% in the next two years), the containment of public IT spendings will no doubt have a negative impact on growth potential. Evolution on the Italian market will also be highly qualitative as Italian software houses face increasing competition from foreign companies and have to adapt their structures to integrate greater European competition.

At product segment level, packaged software expanded by some 9.5% in 1992, application solutions doing particularly well (12.1% growth in 1992). Growth in vertically-oriented packages was significantly greater than in horizontal management packages (payroll and accounting), partially compensating for the reduced availability of applications solutions that has traditionally fuelled the Italian market of medium-sized locally specialised professional service vendors.

Among the professional services, the lack of a standard application range and the somehow related propensity of Italian users for software personalisation generate a continuously sustained demand for custom software. It is estimated that some 40% of medium to large-sized users make use of external development services.

The facilities management business is still small; future growth will depend on the role and attitude of central public authorities in demanding largely FM-based IT projects, the willingness of banks and financial institutions to give up part of their control over their information systems, and the speed with which the manufacturing and services sectors return to concentrating on their core businesses and delegate a certain degree of control over their information systems to external providers.

Although they represent a minor share of the services business, processing services are well developed and value-added network services are increasing and becoming more specialised.

The competitive environment of the Italian software and services industry is more polarised than in other countries: the top three vendors control some 18% of the market, while the rest of the business is shared among the highest number of players operating in the same segment (more than 4,000, including a number of often very dynamic and ambitious small to medium-sized software houses).

Spain

Spain is in a different situation. In 1992, a relatively better performance in the software and services segment (up 14.0%) must be set against only moderate overall IT market growth. Structurally, the market is negatively affected by such constraints as restrictive regulations concerning the telecommunications market, low levels of R&D investment, underdeveloped distribution channels and software piracy. However, growth potential remains high, and the Government's public austerity measures introduced at the end of 1992 should have only short-term consequences on the dynamism of the local software and services market.

Given the general economic structure of the country (where there is a prevalence of small and medium-sized enterprises), the hardware base in Spain is predominantly made up of medium/small-scale systems and single-user platforms; there are much fewer large-scale systems. PCs are often used not only as desktop machines, but also as systems running small and medium-scale core applications manufactured and marketed by local vendors. There are few large specialised processing vendors (except in the banking and finance sector), but network services are fast developing on a vertical market basis – especially in the car industry and the public sector.

The Spanish competitive environment mainly depends on rather localised "semi-captive" market-oriented businesses, created as start-ups by major public or private industrial groups and banks. Foreign (especially US and French) companies are making major inroads in such areas as the development of mainframe management software and banking applications.

Other Countries

The performances of Holland, Belgium, Denmark and the Netherlands, were more or less in line with the European market average, their software and services industry being sustained by the demand from Germany.

In addition to the UK, Norway, Sweden and Finland were the most affected by the crisis of 1992. Although the situation did not actually worsen in 1992, the sluggish economy did not allow any major advance in the UK's software and services market, and the three Scandinavian countries had poor overall performances, with Sweden and Finland (both struggling with tough economic difficulties) doing worse than Norway.

2.2.2. Short Term Evolution

Given the erratic development of the different national markets, it is difficult to identify generalised trends upon which to base forecasts concerning the European software and services market as a whole. However, it is possible to indicate some broad areas which will affect the evolution of the market over the next two years.

When the software and services business is looked at in the context of the overall IT market, it can be seen that a correlation between the general economy and the software and services market is increasingly becoming the rule. This is not only a sign of all developed industries, it also shows that users are tending to see their IT needs in global terms. In other words, there is now an obvious link between hardware, software, services and even (to some extent) communications: if one of these segments is hit by an economic recession, the others also feel the impact – however attenuated it might be. As a result, it can be expected that the market will stabilise around lower or flat growth rates, rather than decline: the packaged software market is anticipated to grow annually by 9% over the next two years, and professional services are expected to have a growth rate of 8% over the same period. Evolutions need to be looked for more in qualitative terms than on the basis of market volumes.

In general, the software, services and hardware maintenance and support market is bound to represent an ever-increasing share of the global European IT market: from 53% in 1992, it is expected to reach 55% in 1994. Packaged software will gain most from this expansion and, by 1994, will represent some 16% of the European IT market. Although having a slightly lower growth rate, professional services will nevertheless increase their market share to 20%; the share of processing and network services should stabilise at about 8% in 1994.

The differences between the dynamics of volumes and revenues are expected to become greater for a number of reasons. Firstly, as the packaged software business becomes an increasingly important segment of the market, its

evolution will have a more profound impact on the software and services market as a whole. The packaged software market is becoming ever more industrialised, and PC software is now sold on such a large commercial basis that it will become increasingly subject to price pressures. Secondly, the relatively greater weight of packaged software on the overall market will make it more sensitive to the hardware situation: for example, the fact that the systems software and utilities market is very dependent on the large-scale systems market and far less dependent on the PC market will tend to act as a market brake. Thirdly, competition is becoming tougher on the professional services market and more contract orders do not necessarily mean more revenues or better margins. Segments such as facilities management, for example, are attracting the attention of an increasing number of players who, in order to defend market shares, are obliged to trim their prices.

The market evolution described above will be affected by the restructuring of the industry that is taking place in parallel with the restructuring of the hardware market. Willing to develop their solutions offer, hardware manufacturers will become increasingly important players on the professional services side and, according to market analysts, this will lead to new hybrid entrants on the European market. Among these, large-sized auditing and consulting firms will use their international experience as a market differentiator, and telecommunication companies will tend to multiply market advances and external growth operations.

Globally, the European software and services industry will be increasingly characterised by two types of vendor: a small number with sufficient resources to position themselves as fully-fledged services providers capable of playing an international role, and a very large number of companies either focusing on niche markets or too small to consider diversification strategies.

3. The Competitive Environment

At the moment, the European software and services business is mainly divided between independent software and services vendors and traditional system vendors; the former account for some 77% of the total business generated, the latter for most of the remaining 23%.

	Software	Services	Total
Independent Software Vendors	53%	90%	77%
Hardware Vendors and others	47%	15%	23%

Source: IDC

Table 10
Western European Software and Services Market by Type of Vendor
% Breakdown on 1991 Market Value

Geographically, European players are estimated to control almost two thirds of the business, thanks to their edge in services activities.

	Software	Services	Total
European Vendors	34%	79%	63%
Non-European Vendors	66%	21%	37%

Source: IDC

Table 11
Western European Combined Software and Services Business by Region of Vendor
% Breakdown on 1991 Market Value

Despite this, the particularly fragmented structure of the market means that two of the top three players in the market are hardware vendors (one US and one European), and that number increases to six (two US) if the top ten players are considered. This is a photograph of a changing process which is affecting other regions as well as Europe, and which is being further driven by the efforts of hardware vendors to clarify their strategies as far as the provision of services and their overall repositioning are concerned.

3.1. General Trends

The rapid evolution of the European software and services competitive environment is not only a result of the globalisation of the European economic market (emphasised by the gradual elimination between EC and EFTA countries, and the opening up of "protected" markets) but also, and above all, a result of the changing nature of user needs and the services offer mix.

The IT business is no longer *technology-driven* (with technology as its key differentiating factor) but *demand-pulled* – which means that the capacity to provide solutions has become the key parameter.

The emergence of increasingly sophisticated user needs is generating a demand which is increasingly differentiated in terms of:

- the size of the user's organisation;
- geographic market coverage;
- targeted vertical markets;
- application specialisation;
- platform support.

The reaction of the market is growing polarisation, with the business of building hardware and software products becoming increasingly distinct from that of providing integrated customer services and solutions.

New typologies and channel players are emerging throughout the IT delivery process in general. Software and services are destined to play a major role as differentiators, even though the provision of integrated solutions are not indistinctly managed by the same operators for the different types of accounts addressed. Within this new environment, the success of competing software and services players increasingly depends on their ability to address these specialised needs at the right time and in the right way.

This has various implications for product and marketing policies. More than the control of innovation and technology, what is needed is the control of vertical markets and specialised application skills; success and security of market position depend on acquiring enough market penetration and acceptance in specialised areas.

Furthermore, the selling of solutions has different constraints from those involved in selling hardware: time to implementation becomes more important than the traditional criterion of time to market. In other words, the crucial factor in a demand-pulled market is not the speed with which system vendors ship new products, but the rapidity with which the end-user can effectively realise the full implementation and (more importantly) the full cost/benefit of his new solution. Finding the optimal time to end-user implementation is essential, and requires a new distribution approach, new coordination of internal services and, in particular, a new way to address clients' needs.

The delivery process is also at the core of the revision of business models. Overall control of the user purchase process and all of the technology and services required for providing "solutions" is no longer feasible in an increasingly demand-pulled market. The "natural" loss of control of user accounts needs to be positively managed within a new organisational structure that privileges alliances and partnerships with systems integrators, VARs and distributors who are already strong in specific areas.

3.2. The Emergence of New Players

The market opportunities generated by this trend contribute towards the lowering of entry barriers to the software and services business for new breeds of entrants who either operate at

different levels of the production/added-value chain, or in sectors other than IT. The most noteworthy initiatives are currently being carried out by:

I. telecommunication operators;

II. consulting firms;

III. application development tool manufacturers;

IV. hardware vendors;

V. MIS departments.

I. *Telecommunication operators* need to develop new higher-margin business lines (in addition to their traditional services) in order to be able to cope more successfully with the increasing competition in the voice communication sector which is compressing margins. It is becoming more important to establish diversification strategies, especially in the data communication equipment and services business. This is reflected in increasing user demand for "integrated" offers capable of addressing not only their voice communication, but also their data exchange needs; the same goes for other formats of communication as well (graphics, images, etc.).

II. *Consulting and auditing firms* are becoming increasingly influential over the IT purchase process of their clients, making it possible for them to target IT users with IT business ambitions beyond their traditional IT consultancy activities. These companies are being more frequently asked to address information management issues (often previously addressed either internally by the clients themselves or externally by large traditional system vendors) because, like traditional management consultancy projects, these are being increasingly seen as crucial competitive factors. This need is particularly acute in Europe, where economic integration and numerous company mergers make IS reorganisation capacities essential.

III. *Application Development Tool Manufacturers* are also rapidly making inroads among the top European software and service providers. By offering users ever more powerful and easy-to-use design and development tools and languages, they are beginning to become a serious competitive threat in traditional service provider markets. At the same time, users are becoming more self sufficient and tend to require fewer customised software development services - it is no accident that bespoke software services are among the slowest growing services on the European marketplace.

IV. *Hardware vendors* and, to a lesser extent, Value Added Resellers are increasingly addressing the software and services market with a new offer mix based on solutions and services. This is due to the declining margins on traditional hardware offerings, and to the fact that users are tending to concentrate more on obtaining the benefits of greater effectiveness and efficiency from both their previously installed and more recent IT purchases. Consequently, hardware vendors are now in the process of redefining their business models and organisations in order to be able to cover all of the implications related to the shift in the focus of their operations from hardware to solution provision.

V. *MIS Departments* at large user sites are beginning to organise themselves into separate operations and to market the activities traditionally carried out internally as a service to external target clients. They leverage on the experience and skills obtained during the repositioning of their departments as profit centres in the core business of their organisations, and have an overall strategy aimed at using the captive market of their traditional activities to ensure financial security while playing on the edge provided by their experience to target other niche or vertical markets.

3.3. Industry Performance Assessment: Independent Software Vendors

Although the traditional independent software vendors still account for 83% of the software and services business, they are not only facing the challenge of potential new entrants; they also have to face structural issues which may become critical in a short time. These issues include the fact that the abolition of trade barriers between European countries will gradually give rise to the problem of critical size: large-sized players will have a definite competitive advantage in their capacity to sustain high levels of investment and encourage extended distribution channels. Many European software and services companies will find it increasingly difficult to obtain from their small niche-specialised businesses the minimum requirements of financial strength and capitalisation, especially if competition and/or recession in their traditional target markets becomes more acute.

3.3.1. European Software Vendors

European companies are actively reorganising themselves, although the pattern of reorganisation depends on their core business and the country in which they operate. The overall results are quite clear: a relatively small group of companies wishing to compete at the higher end of the market and prepared to develop the internationalisation strategies required to fulfill this goal, and a majority of companies concentrating on niche markets.

French companies are the most internationalised, having been largely responsible for the trend towards mergers and acquisitions that has been changing the structure of the European market since the second half of the 1980's. Most are professional service vendors, or combine a packaged software capability with a broad supply of services; their leaders are now particularly strong in the UK, Northern Europe, Germany and the Benelux countries (although few have met with any success on the US market). However, the large majority of companies still operate on a local or national basis. The role played by banks and financial institutions in the capital of a number of large software houses is now being redimensioned and an expected "realignment" (perhaps involving telecommunications operators) will further reshape the industry.

German companies have gained increasing importance worldwide and been particularly successful in the packaged software market; for strategic reasons, the packaged software leaders are now also developing services and support skills. A number of professional service companies have large industrial Groups among their shareholders, who provide a useful captive market; some medium-sized software and services companies have developed important technical skills which provide leverage for growth and expansion, but most of the companies are still extremely localised and depend on a limited number of clients.

The British industry has been largely restructured and a number of medium to large-sized local companies with a high level of vertical expertise are emerging as important players.

The two leading Italian companies are also two of Europe's largest players. Further internationalisation is expected in the near future, with telecommunication operators and large non-Italian groups playing a crucial role.

In general, the vendors in other European countries remain very localised: Scandinavian companies, for example, are rarely interested in expanding out of Northern Europe.

3.3.2. US Software Vendors

Over the last decade, slower growth in their domestic market has encouraged US companies to show increasing interest in Europe; as a result, Europe now accounts for between 30% and 40% of US packaged software worldwide revenues, and over 25% of the worldwide revenues of large US professional service consultancies.

US consulting service providers are among the fastest growing players in the market. They cover a vast range of vertical sectors and skills as a result of their critical size, while most European firms are highly specialised in either one vertical market or in selected horizontal skills (such as human resource management or post-merger reorganisation). This explains the persistence of Europe's highly fragmented industry (in France alone, there are nearly 20,000 companies selling consulting services).

Consulting is drawing particular benefit from the changing competitive environment of users. The coming of the single market in Europe has been accompanied by a wave of mergers and acquisitions which have completely restructured the activities of some large corporations. Business process redesign (a service which lies on the border between management and IT consulting) is becoming increasingly considered as a strategic service which uses management consulting methods and principles to define strategy and objectives. It is a service which makes a significant contribution towards the assessment and modification of the working methods within an organisation based on the progressive adoption of a new strategic outlook.

Over the past few years, an increasing number of users have been focusing their attention on this leading-edge market. As a result, services such as Business Process Redesign (see paragraph 5.2.1.) have developed rapidly enough to compete with traditional professional services. The Big Six management consultancies currently have a 7% share of the European professional services market, and it is expected that they will further strengthen their market position as the advantage of their critical size enables them to leverage on worldwide expertise and concentrate on high-end consulting activities.

The size advantage of US players comes from the availability, at both an international and local level, of a large number of highly skilled professionals responsible for forecasting technology and knowledge transfer for innovative applications (such as artificial intelligence, image processing, telecommunications and object-oriented software development) and developing "technology infrastructures" dedicated to meet specific client needs and support marketing and R&D. Furthermore, they have the financial resources for acquisitions and the establishment of partnerships which allow them to extend their European coverage.

However, the increasing US focus on Europe will not only come from large companies trying to reduce their dependence on the domestic market, but also from a wide range of medium-small companies which have not yet (or barely) started internationalising the sale of their services and systems integration skills - but which have developed extremely valuable expertise that could provide them with a leverage.

3.4. Industry Performance Assessment: Hardware Vendors

The restructuring of the market is inducing hardware vendors to redefine their business models and clarify their strategy as far as the provision of services is concerned.

Only the largest traditional systems manufacturers are big enough to compete on the two fronts of technology manufacture and the supply of solutions; the majority have had to make the fundamental choice as to which of these two activities they will concentrate on.

Consequently, hardware vendors without hardware R&D and consolidated manufacturing process have been increasing their investment in software and services.

Their present 14% market share should go up to 16% by 1994 as they develop their positions on the professional services side and gain the proper business size and client portfolio to support the development of investment-intensive services. As a result of this process, traditional hardware vendors are shaping steadier growth dynamics in the professional services business and a decline in the growth of traditional maintenance services. At the same time, they are losing some ground in the hardware business, as well as in its associated systems and utilities business, which is causing them to lose something of their relatively strong positioning in the packaged software market.

As previously described, the market they have traditionally addressed with high-margin generating hardware has radically changed: they not only have to cope with highly pressured margins, but also with the fact that users are placing less emphasis on hardware power as such because its capacity and efficiency tends to be similar across models and manufacturers. Now, the core issues are those related to systems integration, the availability of tunable applications, and the possibility of entrusting not only hardware but also management needs to a single provider.

In this new environment, traditional systems suppliers can benefit from various key competitive factors:

I. their critical size;

II. the installed base;

III. their technical expertise;

IV. partnerships and alliances.

I. *Critical size:* the advantage of first entering the IT market with a totally integrated offering during the phase of high market growth and in a sort of oligopoly environment is clear, as can be seen from the business share achieved by the strongest system players. If the contribution of software and services is separated from total revenues, the leading systems manufacturers are also the leaders in both the European and worldwide ("physiologically" fragmented) software and services market.

II. *Installed base:* being a first arrival has also paid off in terms of geographic coverage and user perception. Systems vendors have the largest and tendentially most faithful client portfolio. Providing they have been able to establish a good image of competence and service, they certainly have an edge during the supplier selection process because users naturally tend to favour suppliers who have satisfied them in the past, even when the offer mix is broadened or refocussed towards new kinds of services.

III. *Technical expertise:* their experience of providing systems, as well as integration and maintenance services, has allowed traditional vendors to invest in devoted R&D and consequently develop competitive expertise in software technologies (especially systems and utilities software); to develop technical staff skills in providing support and integration intelligence to the vertical markets in which their installed bases operate; and to gain a learning curve edge from their greater contact with the day-to-day problems encountered by their users – a favourable edge for strengthening or accelerating the development of services (especially in the areas of consulting and planning) which are not usually pushed by other traditional systems vendors.

IV. The consolidated position of systems vendors on the global market and/or in specific niches or vertical markets acts as a catalyst in developing potential *partnerships and alliances,*

especially in such a fragmented segment as software and services where the majority of players are looking for business potential to increase their size and financial security. This advantage is even more important in an increasingly demand-pulled market where specialisation in demand core business needs is more significant than technology features themselves. As systems manufacturers become aware that, alone, they cannot address all segments and all types of clients, they can leverage on their coverage to catalyse an appropriate network of partnerships and alliances that will enable them to segment and differentiate their offering mix. Most importantly, given that the specific vertical expertise in the technology and marketing methods for solutions and services is acquired via stake acquisition or joint sales agreements, the necessary level of investment is sustainable. Ambitious and successful alliances have already been launched by a number of traditional system vendors interested in increasing their presence in specific technological or vertical niche markets.

However, these edges cannot be fully exploited unless new business models appropriate to the emerging trends are also adopted. The correct shape of these models depends on the realisation that, in order to understand and effectively address the needs and problems of the end-user, a different approach focussed on vertical markets and applications is needed. In this context, product-line oriented organisations are less effective than organisations oriented towards vertical markets. Furthermore, a segmented view of application user requirements needs to be adopted in order to be able to target the needs of different customers according to their size, geographical origin and market positioning.

Another challenge is represented by the trade-off between global service and locally specialised strategies. At the moment, there are few global service providers; local languages, business practices and customisation have traditionally favored local suppliers. However, as user-enterprises become more geographically integrated and tend to conceive their business on a global scale, there will be a growing need for globally integrated information systems - and consequently a willingness to accept partners capable of offering global follow-up services. For traditional system vendors who have already had some experience of the costs and benefits of a global business, the ability to couple their expertise in broad coverage services with local partnership activities might turn into a remarkable edge. During the 1990s, this will be one of the most important factors contributing towards a widening of the gap between global service providers capable of competing at a worldwide level and vendors focussing on local areas.

3.5. Industry Performance Assessment: Telecommunication Carriers and Manufacturers

The IT sector is seeing the emergence of new technologies and services from the bundling or integration of IT, telecommunication and electronic consumer products. These are targeted to satisfy new IT usage patterns based on optimising the benefits of integration for both the traditional and new IT users coming from the community of consumers. Alliances between telecommunication Groups and software houses are aimed at satisfying the increasing demand for more advanced and IT-intensive public services to be delivered by central and local government administrations.

This will generate new opportunities for telecommunication vendors capable of reorganising their resource and marketing policies in order to expand their geographical coverage and develop activities such as facilities management, network

engineering, banking and management solutions, and EDI applications. It is a process which has long been visible in the UK (where the liberalisation and privatisation of telecommunication services were first implemented), and is now beginning in France and Italy.

It is no accident that US telecommunication carriers and equipment manufacturers have demonstrated a clear interest in being involved in the UK, France and Germany; and their interest is sure to spread to all of the other major European countries.

4. User Directions

From the users' standpoint, the software and services industry is increasingly driven by those players who are first capable of addressing a user's needs with such a meaningful solution that the competition is excluded from consideration. By the time a user has decided to purchase a given software package or service, he has often already decided on his "favoured" provider. Players looking for a competitive advantage need to participate with users in defining requirements and in identifying which sites are predisposed to particular solutions.

This chapter shows how attitudes and perceived challenges can be considered as indicators of a predisposition to technologies and IT strategies.

4.1. Usage Direction Indicators

The trends shaping the evolution of users' software and services purchasing behaviour are more visible in the three major European countries (Germany, France and the UK) than in the US or Japan.

The Use of New Technologies

Perceived technological leadership is a useful indicator of enthusiasm for the use of new technologies and services. The number of early adopters (users who have shown an unequivocally greater propensity to commit themselves to new technologies such as multimedia, object-oriented programming and databases, CASE or Expert Systems) is quite large in the three major European countries and, in France and Germany in particular, considerably larger than the number of early adopters in the US and Japan.

Attention to the challenge of integrating central and end-user resources into a single enterprise-wide information system in order to increase productivity is another driver discriminating a user's propensity to buy new technology. Once again, users in the UK, France and Germany are keener than those in Japan; French and German users are also keener than those in the US.

Management of Distributed Resources

High growth potential can also be found among the champions of distributed architecture (users who have a propensity to move existing applications to smaller distributed systems and to focus on the development/implementation of new applications for such systems). This trend is less strong in the UK, where cost control pressures are greater; but French, and particularly German users are definitely more directed towards distributed resources than those in the US or Japan.

Client/Server Computing

Client/server computing (either as a vehicle for reducing costs or as a particularly attractive tool for integrating an enterprise) is again more positively welcomed in Europe, although there are some differences in the level of acceptance

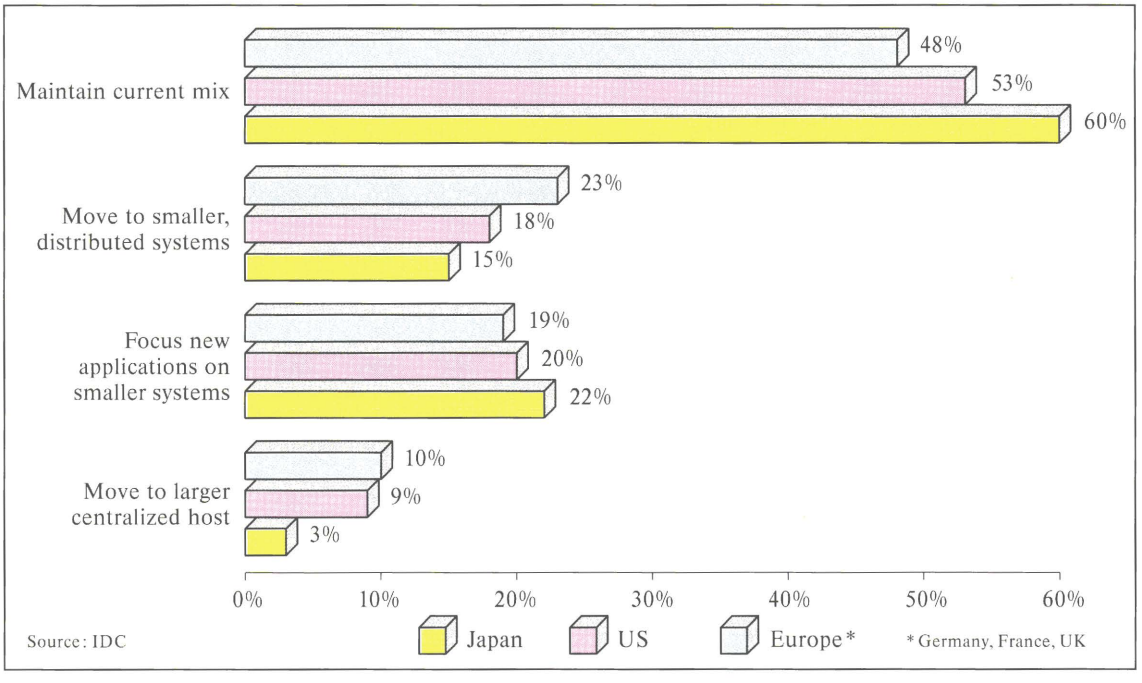


Figure 3
Direction of Centralised versus Distributed Resources for IT Customers in 1992

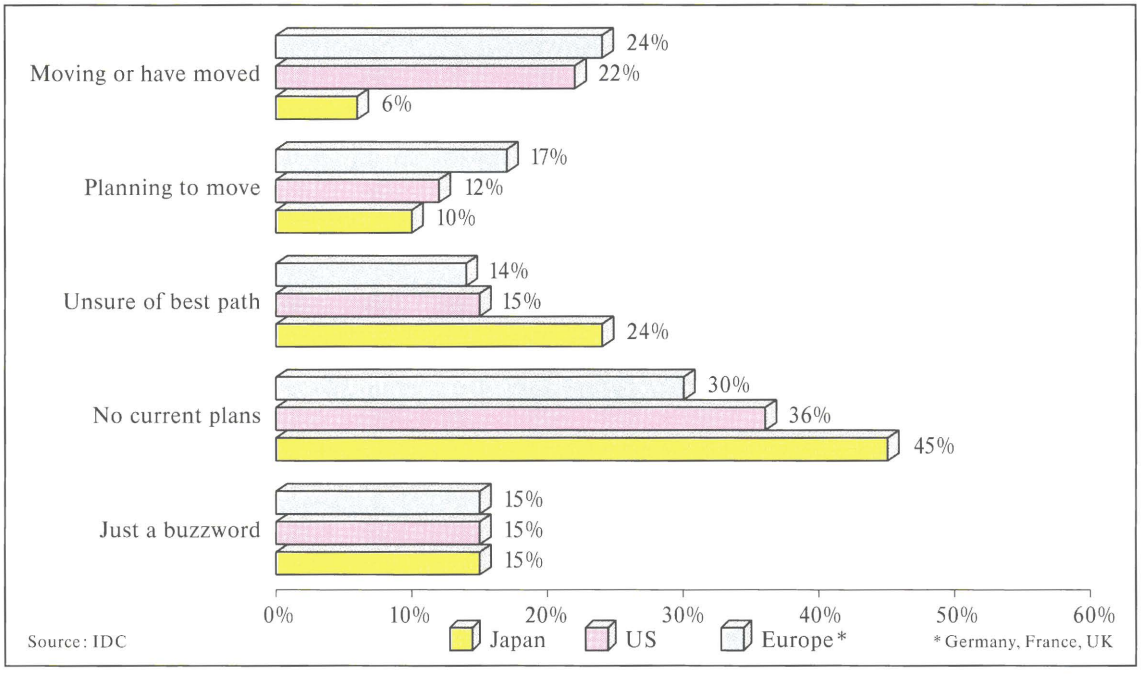


Figure 4
IT Customers Attitude Toward Client/Server Computing, 1992

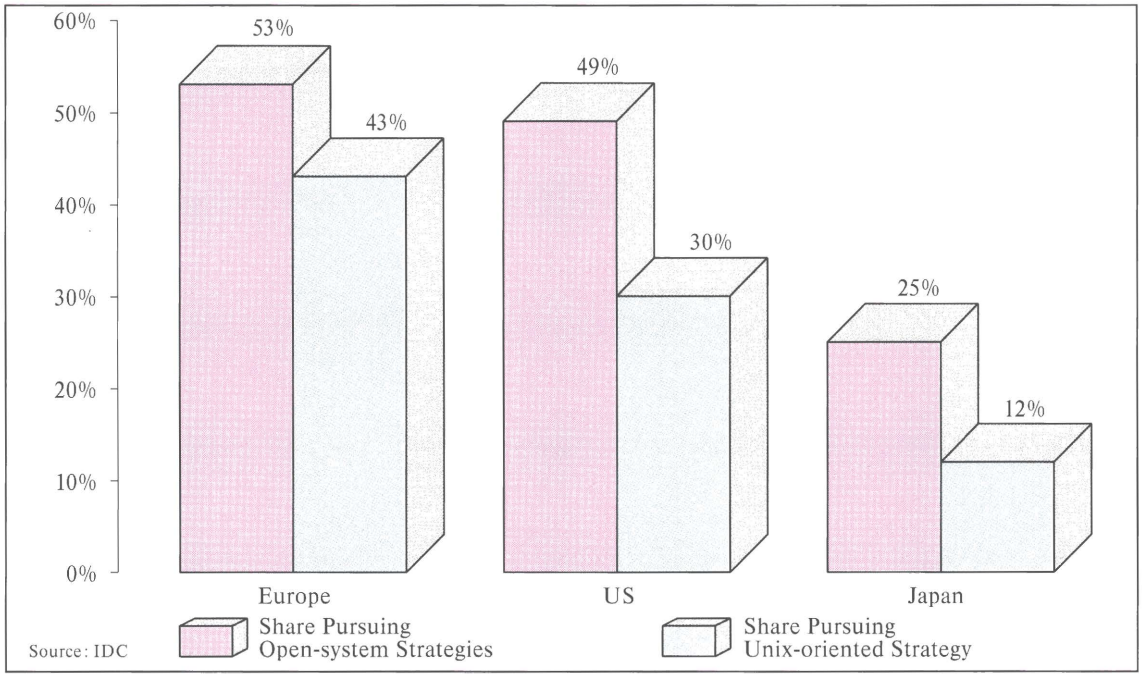


Figure 5
IT Customer Attitude Toward Open and Unix-oriented Systems in Europe (Germany, France, UK) 1992

and type of use among the single European countries. France is the country with the largest number of users who have already moved or plan to move towards client/server architectures, closely followed by Germany; the UK is still far behind.

Although simple client/server applications in individual LANs may be compelling for departmental organisations or small enterprises, their implementation involves most of the complex IT problems known to exist today: for example, the adoption of open system standards and the security of distributed databases.

In all three European countries, more than half of the users use mission critical transaction processing applications in client/server environments, but there are significant differences when it comes to other types of application. Shared print and file management applications are favoured in the UK and Germany, but French users are less enthusiastic; and the same is true for office automation, communication gateways for E-mail and fax, and technical applications.

In general, although it is still insufficiently specified, the need for client/server applications is coupled with the need to simplify client/server technologies – making them an effective part of the solution rather than a part of the problem.

Open Systems

More than 50% of the users in all three European countries are pursuing an open systems strategy, although the means chosen for its implementation varies (sometimes greatly) from country to country.

Unix is undoubtedly the most frequently chosen open system, and the overall percentage of users pursuing a Unix-oriented strategy is sig-

nificantly higher in Europe than in the other geographical markets, the greatest tendency in this direction being shown by users facing the most difficult migration and integration challenges.

In order, the reasons given by users for not pursuing a Unix-oriented strategy are satisfaction with their present non-Unix systems followed by the fact that their application needs are best met by non-Unix systems (which may be coupled with the assertion among early adopters that Unix itself is lacking). Neither the cost of conversion nor the lack of in-house skills is considered a major problem.

The implication behind these findings for specialised Unix software and services players is to leverage on Unix features as a key to enterprise integration via information sharing and as a cost-effective target migration platform. The challenge will be to demonstrate sufficient integration with conventional system management environment tools to allow the delivery of the level of service and reliability necessary for enterprise-wide systems.

Outsourcing

The vast majority of users have no current interest in outsourcing data center and/or network management operations: nine out of ten users in Germany and the UK, and seven out of ten in France.

Among those users contemplating or currently using outsourcing, this is more often chosen for data center operations and comparatively rarely for network management (although almost 50% of UK outsourcers use it for both). In general, greater interest is shown by users going in for system modernisation.

Systems Integration

Also limited is the use of systems integrators (vendors who provide a comprehensive information processing solution through a unique combination of professional services and expertise in hardware, software and/or communication technologies). Only two European sites in ten currently uses or is considering using a systems integrator, and the picture is similar in the US and Japan.

French and UK users are the most willing to develop closer relationships with systems integrators, tending to consider them for all or most major IS activities; the interest in Germany is somewhat less. Other considered options are to use systems integrators for one or several strategic applications, or on a one-off project-oriented basis (which is particularly favoured in Germany).

Most of the users who have no plans to use a systems integrator are simply satisfied with their existing in-house resources and services, although more than 20% in France and 25% in Germany expressed a fear of becoming dependent on outside suppliers (as against only 13.5% in the UK).

Network Management

The majority of users have no overall network management strategy, while such a strategy is considered a priority by the rest. A substantial minority of early adopter sites and sites with integration objectives do use enterprise management systems, although more than half of the sites facing a migration challenge still have no network management strategy. These latter companies represent a potential prospect pool for vendors with network management tools and services.

4.2. Users' Software Spending Patterns

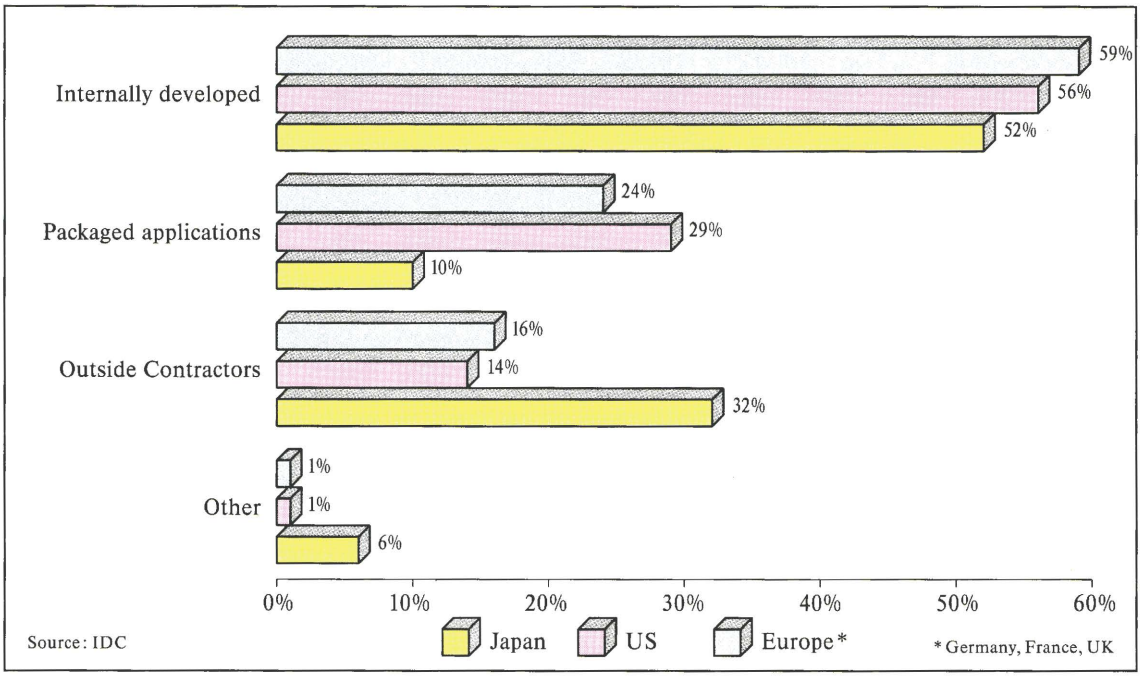
On average, users have maintained more or less the same mix of internal and external spending over the last few years. In-house software development still dominates software spending, more than half of the total application software budget being allocated to internally developed applications; packaged applications generally account for the second largest share of the software budget, while the rest is allocated to applications developed by outside contractors.

The highest share of software spending for packaged application solutions is recorded in Germany, followed by the UK; in France, the percentage is considerably less because they dedicate as much as 85% of their software budgets to internally and outside contractor developed applications.

More than one-third of software staff time is spent on developing new applications in all three European countries, with France dedicating over 40% of staff time to it. UK and German users tend to devote more time than French users on other tasks such as systems conversion, the provision of end-user access and the building of new user interfaces – relying more on external packages for their software needs.

As far as training is concerned, the most important areas over the next two years will be internal IS standards/procedures and network management/operating systems, followed by training in CASE, life-cycle tools and methods, open systems/Unix and object-oriented technology. Training is considered significantly more important for achieving application development and maintenance tasks in Germany.

Figure 6
IT Customers Allocation of Software Spending



Increasingly complex computing environments, as well as developments in new software technologies, make support services ever more essential. In general, German users acquire more end-user support services than those in France (and much more than those in the UK), showing a preference for hardware installation and software migration services. A similar pattern emerges when network design and maintenance services are considered, and Germany acquires considerably more back-up and recovery services than both France and the UK.

4.3. Line-item IS Spending

Line-item IS spending depends on the particular challenges facing individual sites and the way in which these challenges are being met. The challenge of migration is a good indicator of above-average expenditure on IS personnel. Expenditure on mainframes and minicomputers is unexpectedly high at sites facing the challenge of maintaining and training staff; conversely, these sites are not investing in PCs or workstations. Naturally enough, sites facing cost control challenges have the greatest need for outsourced services.

At those sites which claim they only rarely make more than marginal changes in IT expenditure, there is a positive attitude towards spending on IS personnel, packaged software, and network hardware and services. Deviations from average expected expenditure on packaged software are generally small.

Germany reported a more positive pattern of budget increases in 1991 than either France or the UK. As far as 1992 was concerned, French and UK users declared a further decrease in their IS spend (greater in the UK). German users were also more pessimistic: the number of users anticipating increased spending went down, and the number anticipating no change went up.

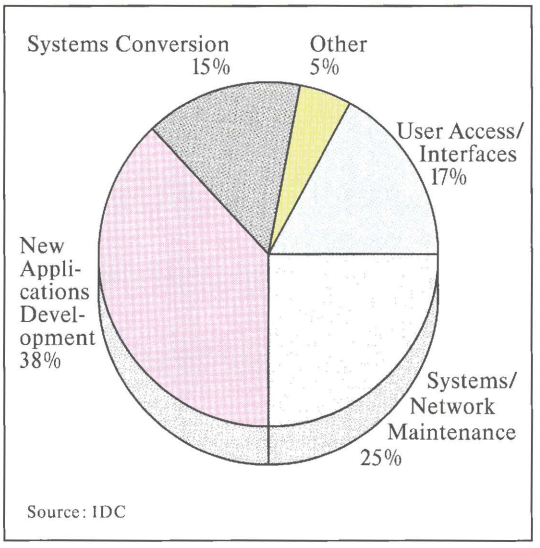


Figure 7
Proportions of Software Staff-time Spent on Different Activities in Europe (Germany, France, UK) 1992

In terms of line-items, IS personnel spending in 1992 was severely hit in France and the UK; in Germany, budgets benefitted such spending. Hardware expenditure was also severely hit, including the expenditure on workstations, PCs and servers (particularly affected in France, less so in the UK).

The crisis had a direct effect on standard software products in France, where packaged software budgets were reduced. On the contrary, UK and German users were less prepared to sacrifice software product expenditure. When economic times are hard, the average French site tends to rely more on its abundant internal DP staff and self-develop the software it might otherwise have considered acquiring from external sources, while the average UK user tends to privilege the more economic solution of reducing internal development in favour of cheaper standard products.

Although to a lesser extent, French users also reduced their spending on services – further confirmation that, in times of an economic downturn, the average French user first privileges internal developments, then customised services, and only turns to software products as a last resort. In the UK, there was an increase in services spending – which confirms the tendency of UK users to look for outside development services which are cheaper than internal services.

German users continued to privilege packaged software but, like users in the UK, they showed a propensity to turn to services in 1992.

5. Technological Implications

The industry trends and user requirement patterns outlined above are helping to shape new developments in software technologies and new kinds of services. This chapter analyses the new characteristics and relationships emerging in the software and services market mix in terms of additional market for new products and services, as well as in terms of substitution in the more mature segments.

5.1. Packaged Software

The packaged software offer mix is affected by the greater attention that users are giving to cost control and the maximisation of their DP investments.

Organisations tend to favour products which are more efficient in enabling closer control of DP resources and ideal monitoring procedures, provide information systems with cost-beneficial value-added capabilities, and which help to minimise the need for large-system operating staff (one of their largest cost allocations).

The existing prevalence of heterogeneous distributed and networked hardware environments is gradually leading to a shift in user demand towards tools which facilitate the transition to open systems and decentralised computing. The objective of the users is to be able to control the management of their hardware bases continuously and automatically in order to address cost control requirements and increase productivity.

The growing acceptance of distributed processing and downsizing means that users require greater integration of platforms and operating systems. Hardware vendors have been placing increasing emphasis on this aspect, developing architectural standards focused around interoperability, data communication protocols, data models, standardised data access and application programming interfaces.

5.1.1. Systems Software and Utilities

The systems software and utilities market is becoming strategically more important as users begin to shift their attention towards achieving more control over the management of their DP resources and optimising the use of their hardware base.

Different trends are emerging at the level of specific tools:

- *Performance management software* is evolving towards the development of a larger supply of automated performance measurement tools designed to allow organisations to manage the balance between their computer resources and workload in a more dynamic manner. As this market develops, the integration of Artificial Intelligence (expert systems) into performance management software will become an increasingly important issue.
- *Business management software* is evolving towards more heterogeneous and decentralised forms of computing, with the objective of integrating information from multiple operating environments and network architectures. Other increasingly important product requirements are LAN performance checks and co-operative processing.

- *Problem management software* is one of the core products for data centre management which is increasingly matching user needs through improvements in system performance and connectivity.
- *The management of change* is becoming an increasingly strategic issue as development environments become more sophisticated and networks become more complex and inter-connected. Systems vendors are placing particular emphasis on this because of the spread of heterogeneous systems incorporating multiple operating systems and the need of end-users to optimise the management of their software resources.
- *Configuration management software* is acquiring a similar level of importance as a consequence of the diffusion of distributed processing environments and multiple operating system hardware bases. Previously dominant in this market, hardware vendors are now facing increasing competition from software vendors.
- In the *operating systems software* business, Unix and single-user PC system environments are developing their functional levels and therefore gaining a growing share of the market at the expense of traditional mainframe environments.
- *Network operating systems* are also growing rapidly.
- *On-line transaction processing* (OLTP) is a growing area of focus for both systems manufacturers and software vendors (especially data base management system vendors). OLTP covers specific areas of both system and utilities software (operating systems, communication protocols and graphical user interfaces) and the application tools segment (transaction applications, transaction management software, query languages). Interest in OLTP is growing in terms of its relative share of IT spending, with performance and availability being the two competitive factors. Hardware vendors still have a strong influence over the design and performance level of OLTP software because the competitive advantage of their large installed bases enables them to cover development and maintenance costs with greater revenues.
- The evolutionary trends of the supply of *Unix-based systems and utilities software* are clearer than in the past. After almost ten years of commercial use, OLTP architectures have come through the phase of technological take-off and are enjoying a more consolidated market position. Unix-based OLTP is increasingly capturing the attention of traditional system vendors who are beginning to port their products onto Unix platforms. Users will find a remarkable competitive advantage in products that allow them to migrate or extend existing proprietary transaction processing applications to the cheaper Unix hardware platform, and to capitalise on existing application programming knowledge.

As users tend to require a minimum number of advanced system software features as a natural component of their hardware, it is reasonable to expect increasing price pressure in the systems software and utilities market, which will probably lead to further rationalisation or company mergers.

In this segment (which has been dominated by traditional system and independent US software vendors), the future of European companies is more linked to niche strategies. European packaged software companies tend to be considerably smaller, which means that the industry is extremely fragmented – and this leads to a lack of marketing strength and unsatisfactory distribution channels. In order to be successful, European companies will need to strengthen their price flexibility and client support.

5.1.2. Application Tools

The application tools segment is also undergoing profound changes. These are due to the fact that users are moving towards client/server applications and downsizing is tending to transfer development to smaller, more powerful platforms.

- *Development languages* (traditional third generation languages and utilities) contribute most to the business of the application tools segment: not only are user organisations demanding better-integrated and easier-to-use tools, the growing development of object-oriented languages will also fuel this market in the short term. Although the market is still concentrated on mainframe-based tools, it will shortly show a steady increase of the share of Unix and single-user system-based tools.
- *4GLs and Report Writers* have received ready market acceptance thanks to the ease with which users can access and analyze information. At the moment, the market is oriented towards products available across different types of platforms and databases, as well as towards products aimed at developing client-server applications; however, increasing competition from CASE tools is expected, and this is likely to affect vendor revenues.
- *Middleware* software is a strategic issue, because it addresses critical market requirements. The growing sensitivity to the question of heterogeneity on the part of both hardware and software vendors means that interface standards are becoming increasingly necessary in order to allow the implementation of truly open system environments.

  A large number of organisations or vendor pools are trying to position themselves in this area by producing standards at the three different levels of data management, distributed computing and presentation management; and most system vendors have been trying to develop architectural standards through frameworks or profiles which respond to the data centre needs of interoperability, data communication protocols, data models and standardised data access. One of the results is that the market already has a large number of multi-vendor standards (network management systems, for example).

  Standardisation is becoming a key parameter for evaluating the chances of success of any strategy. Within the Distributed Management Environment (DME) of the Distributed Computing Environment, the Open Software Foundation is trying to provide and promote technology at the system management level of client/server architectures with the objective of achieving the diffusion of *de facto* standards. DME includes multiple layers and components which go from core services to management application programming interfaces.
- Although the tecnology of *data base management systems* has reached maturity in some respects, the rapid migration of users from flat files and non-relational databases to new relational DBMS is revitalising market growth. The European market is also benefitting from its relatively more dynamic Unix market, especially in the commercial segment.

  It is also expected that a major contribution towards the reshaping and extension of the life cycle of database management systems will come from the spread of object-oriented DBMS (LAN-based engines supporting graphical user-interfaces and addressing complex object and multimedia needs).

  Competition across mini and PC/workstation platforms is intensifying as PC vendors move uspcale to address a wider variety of information access needs. In the mid-range, there is a clear trend towards more cost-effective LAN-based systems using client/server architectures running graphical applications. Mid-range vendors are seeking to attract mainframe

Preimplementation	Implementation		Postimplementation	
Information Technology Consulting	Contract Programming and Software Development	Systems and Network Implementation	Education and Training	Systems Management
Planning Requirements analysis security audit resource audit work flow analysis IT strategy analysis migration planning architecture development Business process redesign *Design* Systems design	Contract programming Custom software design and development documentation testing Software customisation Software reengineering Translation	Site preparation Cabling System installation System migration activities Subsystem integration Testing	Analyst/Programmer training Computer operations training Management training End-user training	Internal staff assistance Internal systems operations mgmt. External systems operations mgmt. **Processing Services** Payroll Transaction processing services Timesharing Batch processing

Source: IDC

Figure 8
Services Diversification

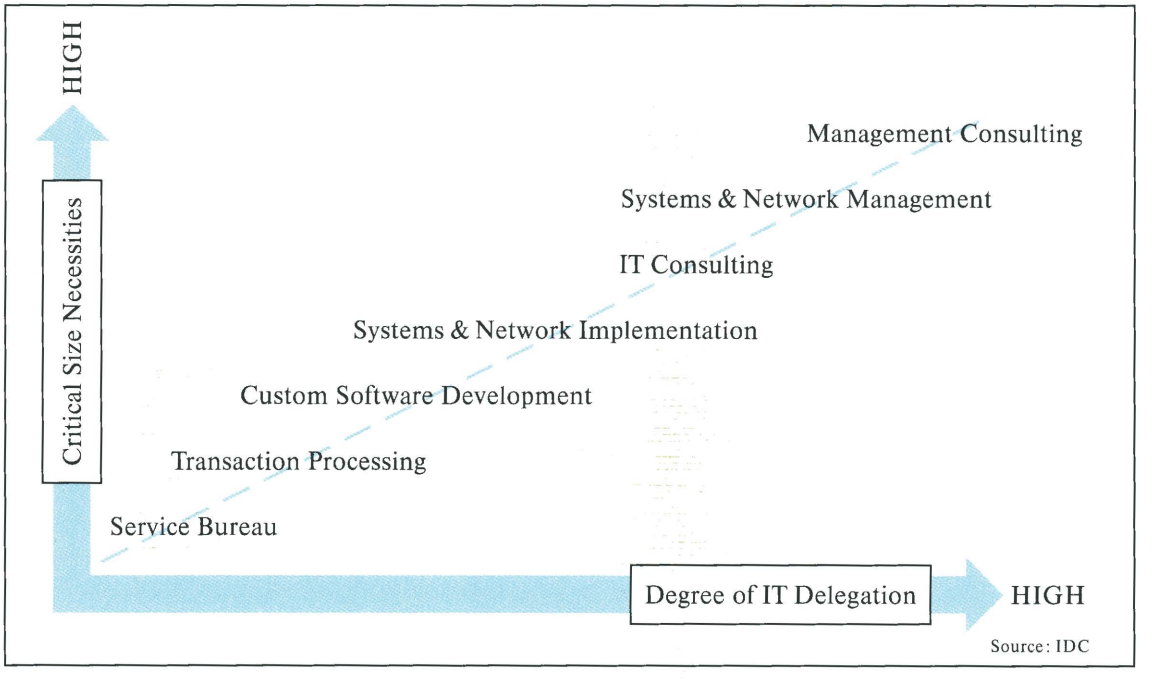


Figure 9
Critical Size and Delegation over Information Systems Management

DBMS users via more cost-effective servers and easier-to-use front-end tools. The availability of this new technology is likely to increase user interest in mid-range and small-scale DDMS systems.

- After coming out of the development stage, *Computer Aided Software Enginering (CASE)* has finally become a commercial reality and now accounts for a growing share of the European application tools market. User demand is clearly focussing on products covering all phases of application development, from prototyping to maintenance.

  At the same time, users are requiring reverse engineering tools as they are increasingly concerned about the future of their installed investments in software. The demand for single-user, especially workstation-based systems is also expanding rapidly.

  It is expected that the market will gradually privilege tools dedicated to the development of client/server applications or the generation of graphical user interfaces, while the industry will tend to address technical issues (such as the integration of development and target platforms) more efficiently. Despite the fact that workstation hardware is less expensive, a large number of users will still be concerned about price issues, and are likely to refuse a specific and not very flexible software development life-cycle.

  The evolution of the CASE market will also be shaped by the internal conflict between technical and commercial CASE applications.

  Technical CASE is reserved to engineering staff involved in designing and testing process control. This is one of the fastest growing areas and is still controlled by a small number of mainly US companies. Technical CASE technology is becoming a competitor in the commercial CASE arena as technical CASE vendors increasingly play on the robust testing and simulation capabilities of their products in order to position them above the building of business applications at engineering facilities. This is a strategy which will certainly be successful at engineering and manufacturing sites with complex application development needs. The complexity of distributed commercial applications will accelerate this evolution. Users need tools enabling them to test the efficiency (response time) of applications before they are implemented: technical CASE appears a offer a viable solution which allows the performance problem to be moved upstream in the system design life-cycle. Leading technical CASE vendors are already developing bridges between their integrated offer and the technical world.

- The European *spreadsheet and statistical package* business is largely dominated by US vendors. Competition is very tough, with players competing to convert existing users of other packages and, as a result, upgrades are becoming an ever more important source of revenues.

  Competition is expected to become more selective as users focus more on questions of integration allowing them to enhance groupware environments, demanding the ability to integrate products, platforms and people. A smaller number of vendors will be capable of sustaining the necessary investments to target "extended enterprise" needs.

- *Other tools,* including data access, decision support and executive information system products are attracting greater user attention as the gradual spread of local area networks engenders a need for functions which enhance data accessibility and enable (for example) more comprehensible data displays. Vendors are trying to improve the ability of their products to access information on different platforms.

As far as executive information systems (EIS) are concerned, a steady growth is expected for PC-based products. Cheaper, more easily installed and fast single-user based EIS will benefit from downsizing, whereas commercial data bases will tend to move towards the workstation market (especially if UNIX-based).

As they strengthen their offer, hardware system vendors are playing an increasing role in this market. The greater availability of PC-based products (a more viable alternative to full-scale host-based implementations) is reducing the temptation of users to develop their own EIS by means of non-EIS-specific tools and directing them more towards LAN-based EIS than host-based solutions.

5.1.3. Horizontal Solutions

- *Office automation products* are among the most widespread solutions adopted in Europe. Word processors represent the hard core of this segment and, given their relative maturity, draw market potential from replacement shipments (upgrades of older models). The adoption of Windows-based applications on new PC hardware makes their consequent adoption or enhancement on wordprocessors a growing source of business.

  Enhanced products tend to integrate more desktop publishing features (graphics, flexible fonts, enhanced printer support), but this growing overlap induces a price competition which may adversely affect the vendors of word processors. In this context, customer service tends to become a vital differentiator for users (access to a service hot line and technical support).

  Integrated office automation packages still represent a limited market, although supply has been expanding steadily. User acceptance is expected to increase as vendors continue to support actively integrated packages with the release of new better-integrated products and as the low-end of the segment is developed. Windows-based technology offers many of the advantages of integrated packages, such as interoperability among applications, data sharing, consistent look and feel, lower cost (as well as lower systems power requirements). This will increase the attractiveness of integrated packages as low-cost alternatives to individual standalone applications.

- The *management package* market is becoming saturated, particularly at the mainframe level. Maintenance services are becoming a key source of revenues, especially for vendors with a large installed base. Nevertheless, the downsizing of applications is leading to a major change in the style of competition.

  Users' needs tend to be increasingly focused on an ideally integrated product ranging from commercial management functions to personnel and payroll management (going through production management, purchase management, accountancy, analytical accountancy and after-sales services management).

  The incentive to purchase is increasingly based on the availability of new technologies in traditional products as well as on productivity issues (for example, through common user interfaces across products). The downsizing of accounting applications especially on the mid-range is encouraging the need for modular products as well as the take-off of distributed applications.

  Payroll and human resource management packages are very country-specific because of local regulations. The increasing cost of recruiting and training personnel has lead to a growing awareness of human resource management as a strategic corporate function. Investments in evaluating employee needs, career tracking and planning are surging and sustain the development of this market.

- *Project management software* is emerging as it allows the implementation of an organisational strategy for controlling tasks required to complete a project. Project management packages include automated planning and scheduling functions to organise and analyse data relating to project constraints (costs, material, manpower).

  Despite specialisation in different vertical-applications, project management software relies upon a high level of common requirements and functions. High-end solutions, usually mainframe-based and requiring intensive servicing, are mainly used in complex industries (aerospace, defense industries, manufacturing). Low-end PC-based products are quickly developing, and high-end products vendors have recently been adding PC-based front-end interfaces and enhanced interactive graphics capabilities to their ranges.

  The usually cheaper Unix releases will have remarkable market results, especially at the low end of the market where low-priced easy-to-use products are being aimed at smaller sites. However, as single-user systems become increasingly powerful, the custom features of high-end PC-based solutions will ensure that they remain attractive (providing they become more user-friendly) for a large part of the market, particularly for project managers.

5.1.4. Vertical Solutions

In terms of vertical solutions, manufacturing, the public sector, banking and finance represent the vital areas for the European market.

- In the *Banking and Finance* market, integrated banking systems are slowly emerging to compete with internally developed software and threaten service bureaus and facility management services. But large-scale financial institutions still generally prefer customised solutions and refrain from delegating part of their control over their information systems by acquiring integrated packages, and the requirements of large banks often involve a higher level of specificity that standard applications might not be sophisticated enough to address.

  Small and medium-sized institutions on the other hand should represent a growing opportunity because they suffer from a dearth of in-house skilled labour and are very attracted by the cost advantages of integrated standard solutions.

  Another important factor for the evolution of the packaged software market on the banking and financial market is the increasingly global and integrated user requirements that reflect upon the demand for products capable of interfacing with other software technologies. Users are increasingly demanding such features as openness to DBMS standards, communication between heterogeneous hardware bases and implementation on client/server architectures (with data hosted on several systems).

  DBMS will be a central issue as products have to make more intensive use of existing data wherever it may be hosted. This trend will have increasing effect on vendor strategies and will certainly motivate more partnership agreements or more external growth operations as software vendors try to acquire the necessary technological platforms and skills.

- *Manufacturing packages* are also evolving towards increased complexity. The integration of new technologies (artificial intelligence), the range of needs (workshop supervision, real-time production management, design and robot programming) and the specificity of industry requirements are all trends that tend to broaden the supply target and encourage increasing R&D efforts on the part of vendors.

The acquisition of a package tends to be a more committing decision in terms of organisation, and this leads to a demand for broader IT skills and management consultancy service capabilities on the part of packaged software vendor. For example, the purchase of computer integrated manufacturing applications requires a precise planning process that takes into account factors such as structure or facility capacity if potentially very expensive mistakes are to be avoided.

CIM and just-in-time manufacturing packages will sustain the growth of the market as they help users to minimise expenses on manpower, inventory, etc.

To overcome the first signs of market saturation, vendors are offering add-on modules (scheduling, quality control, process planning, simulation and cell control). EDI functions will also tend to be a growing differentiator for users, because they enable companies to communicate more easily with their suppliers, distributors and customers.

The evolution of integrated manufacturing systems will be partly conditioned by the standards issue. Users are eager to find systems that effectively interface with their already existing applications base (whether it was developed internally or purchased). Integrated packages can often satisfy a certain level of requirements but need to be customised if they are going to give full satisfaction. The process of enhancement towards higher levels of integration is often long and expensive, which is why more add-ons than complete packages are currently being shipped.

- The *Public Sector* is faced with the same basic needs as the commercial marketplace. They need to implement better systems to cut costs and shorten process cycles while maintaining much of their existing systems. This segment has huge potential in such processes as document management and transaction processing. The vertical market applications of particular interest include taxation packages, local government resource management, pollution and environmental control, the automation of transportation, law enforcement and legal packages.

The technical capacity of vendors is a vital element for success. Strategically, integrated packages are pushing software vendors towards widening their product and service ranges upwards (requirements analysis, consultancy) and downwards (training, technical support, telemaintenance, evolutive maintenance).

5.1.5. Unix-based Software

The growth of the Unix-based software market has been and will remain high.

As the commercial use of Unix multi-user systems becomes more widespread, the need for data centre management systems and utilities software is increasing significantly. The use of management software will be greater at sites with medium-scale Unix systems, while penetration will be rather slow on single-user platforms. Operating systems will grow, especially in low-end segments. The market for systems utilities will benefit from the growing acceptance of client/server architectures, which will lead to an increase in spending on system utilities software per system.

Program development software is another very important area for Unix, since between 25% and 30% of all Unix systems are currently being used for software development purposes. Sys-

tems used for technical and primarily commercial applications will tend to increase comparatively more rapidly, while object-oriented methodologies will contribute to the expansion of the program development market only in the longer term.

Unix DBMS are suffering from fierce market competition, and the shift from platform to user-based pricing models will increase price pressure. However, embedded RDBMS in object management and other workgroup applications will spur the market in the longer term.

Data access and executive information system software products will be spurred by rapidly increasing information repositories and databases. Growth will be favoured by the demand for effective use of this information and increased penetration on single-user platforms.

In the area of application solutions, growth of graphics software will be driven by the increasing commercial use of Unix as well as by relatively high growth in single-user Unix systems. Among horizontal applications, accounting software has reached a relatively high level of penetration, particularly on multi-user systems. Despite their still relatively high growth potential, market growth for Unix accounting packages will be hampered by the perceived lack of security and stability of Unix. Personnel management software has been lagging behind, but greater growth is expected among medium-scale systems as Unix becomes commercially more accepted.

Office automation software is today focused on medium-scale Unix multi-user systems. But growth will begin to slow down as users become more selective about adding more office automation functions to multi-user Unix platforms due to the competition from single-user desktop systems. On the other hand, small servers and single-user systems will represent a growing share of the Unix-based office automation business.

Of all technical applications, CAD/CAM is the largest sub-segment, and workstations the primary platform. Some growth is expected in the use of CAD/CAM, which will be primarily generated by user sites using Unix for both technical and commercial applications. In general, commercial applications will outgrow technical applications.

5.2. Professional Services

Professional services represents the market segment in which European companies have succeeded the best. To maintain their position in an increasingly global and highly competitive environment, European players have started major reorganisation processes aimed at creating large-sized groups.

The nature of the market is changing as user organisations are becoming more autonomous in satisfying their development needs (through the adoption of more powerful development tools) and now require different types of high-end services. Furthermore, increasing emphasis on the control of DP-costs is encouraging the demand for external management services (facilities management).

5.2.1. IT Consulting

IT consulting is the second largest professional services segment. It represents one of the most important challenges for European companies, who are multiplying their efforts to face growing competition from an increasing number of non-European companies.

The evolution of the offer features an increasing integration of business process redesign (BPR) tasks with the consequent gradual blurring of the border between management issues and DP strategies.

Business process redesign is the methodical restructuring of business processes and management systems within an organisation by adapting the IS to a new level of business performance. It enables the reformulation of work procedures, organisational boundaries, job responsibilities and reporting structures, and it brings in the appropriate technology to permit the achievement of these new goals. It aims at increasing the speed of innovation, and the flexibility and profitability of information systems. This meets the users' new emphasis on the need to know how MIS departments and IS can efficiently dovetail business trends and strategic options. Service vendor activities are consequently becoming more concentrated on integrating the management structures of users, as they become direct counselors on the better tailoring of IT systems to the needs of enterprises.

The business process redesign services that are being adopted in the mix of traditional system vendors through strategic partnership agreements are creating more competition to traditional providers.

Due to the increasing importance of the IT consulting services industry, both independent software and traditional system vendors are either creating dedicated business units or subsidiaries within their organisations aimed at targetting these services, or making acquisitions to obtain these skills.

The development of the activities of these consulting services units is being managed independently from the head units, focussing around organisation and IS consultancy services, as well as organisational redesign projects and strategic consulting services.

The consulting units of the leading European software and services vendors specialise in large-scale projects through "business transformation consulting", which may cover the redesign of the order-processing or customer communications system, or the shortening of the "product-to-market cycle". IT and organisation consulting are being coupled with "core business consulting" to assist users in competing on their markets.

However, the barriers to entry in this kind of business remain very high. Diversification strategies towards IT consulting are very expensive and difficult to manage. Many mergers have failed because of the impossibility of merging different management cultures, with high losses in skilled personnel losses.

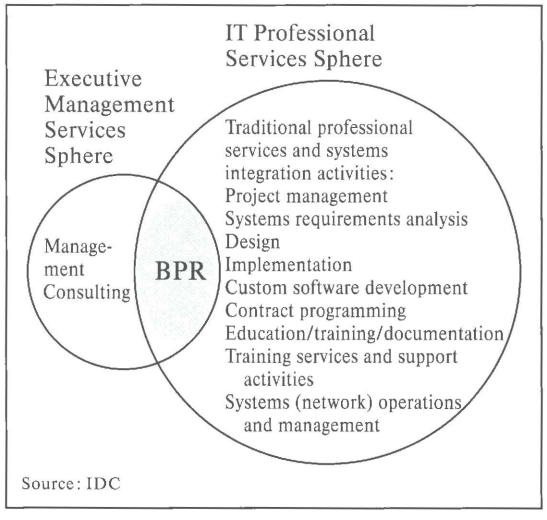
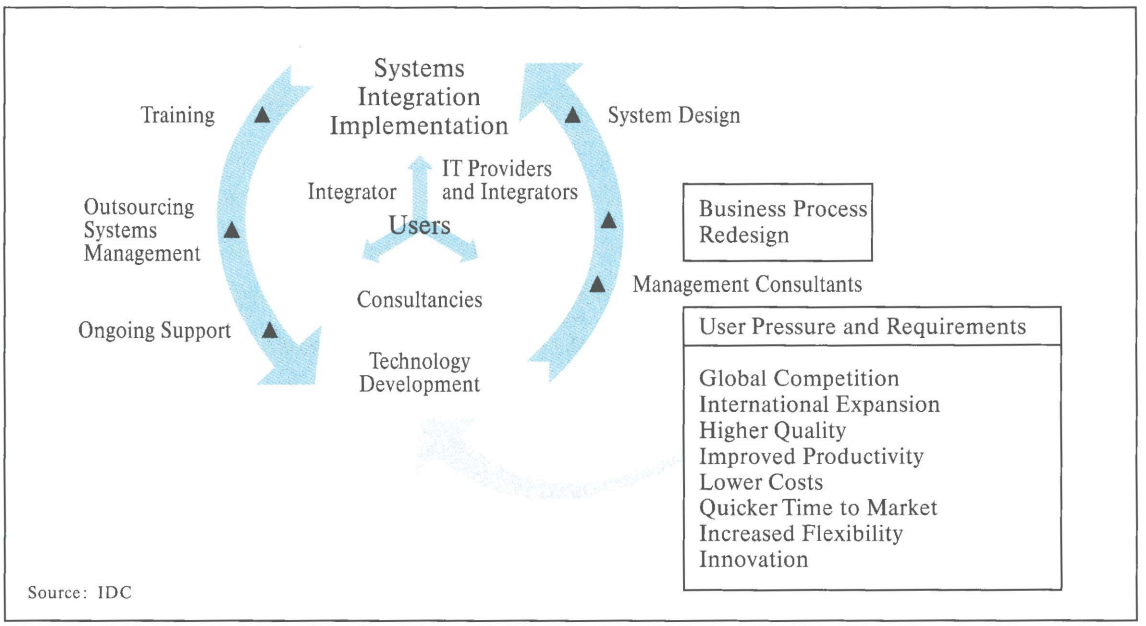


Figure 10
IT Consulting Convergence

Moreover, extending competences towards IT consulting services is successful only if some skills in other strategic services (such as facilities management) are already in place. Users wish to interface with a single services provider capable of understanding and solving the whole range of their IT needs, and this is possible only if a minimal critical size of business is reached. Otherwise, doing business in IT consulting implies further specialisation through niche strategies (one specific vertical market or one specific type of problem) or finding collaboration channels with full-pledged companies.

Figure 11
The Impact of BPR on IT Purchasing



5.2.2. Custom Software Development Services

Custom software development services have always been at the heart of the software and services business because of the traditional attitudes of European users in adopting software technology.

In comparison with the US or Japan, Europe has a "hybrid" attitude. In the US, the extension of a single language market and the large number of user groups wishing to standardise their DP operations over the country have favoured the development of the packaged software market. In Japan, for cultural and management reasons, user organisations have always favoured the development of customised solutions fitting their own needs and satisfying their requirements of confidentiality.

The European situation is midway between these two models. The existence of a large number of countries and different languages has long favoured the development of a custom software industry, especially in countries such as France and Italy (although the UK and Scandinavia are more ready to accept packaged software). However, this situation is changing as users gain software development autonomy through the use of more powerful CASE and 4GL tools.

The high degree of fragmentation of the industry is due to the low level of primary human and infrastructural investments needed to start up a business, which enables the majority of professional service vendors to act on a local scale. But the "life expectancy" of many small-sized companies is becoming shorter as pressure on development service prices rises. Fixed-cost development contracts, better suited for mastering DP expenditure, tend to be preferred to traditional cost and fee staff delegation contracts.

Various factors are at work in the competitive environment of custom software providers, changing using demand patterns, imposing a

different economic environment and driving competitors towards adopting more efficient cost models and project evaluation methods.

Two of these factors can be singled out:

- competition from packaged software;
- price pressures.

Competition from Packaged Software

Packaged solutions are gradually entering into fiercer competition with bespoke software for a number of reasons:

- packaged software meets increasing price/efficiency concerns on the part of user organisations, as well as the need for solutions on the part of a larger number of end-users who are being provided computer power through the diffusion of networked computing and standardised user interfaces;
- an organisation will often consider going for a standard software package if its clients and suppliers already use it because this enables the faster and more reliable integration of information systems;
- the integration of commercial, financial and transport/distribution functions with manufacturing issues becomes easier through the availability of a large catalogue of modular packages with sector-specific modules covering a broad spectrum of market needs;
- non-mission critical applications (such as payroll) are increasingly acquired on a packaged basis.

But the adoption of standard solutions is hampered by another set of factors:

- education tends to become critical when the new packaged product is completely unknown to the in-house development personnel who are still required to answer problems as rapidly and as efficiently as before;
- DP strategies on customised developments around the packaged solution can be jeopardised when problems concerning the compatibility of new releases arise;
- the use of packaged products is not always maximised because of insufficient involvement in the "discovery" of their potential;
- although standard software products are becoming more flexible (especially through the development of modules), they can never fully meet all user requirements and specific needs (in terms of heterogeneous or networking environments) nor the requirements of compliance with already existing custom software in the organisation;
- as software solutions become more comprehensive, consulting services are seen as a logical corollary. New software often makes management reorganisation necessary, as it displaces useless processes and reallocates information flows. The introduction of a new solution also often requires training activities to ensure that the software is used to its full potential.

Consequently, packaged software vendors are developing their service capacities in order to satisfy customer needs, leveraging on their large installed base and the growing importance of software maintenance services.

Price Pressures

More so than in other services, price is becoming a key competitive element for customised solutions. This factor is exacerbated by the dearth of skilled programming personnel with which both users and independent software vendors have to contend. Off-shore programming services tend to be seen as an opportunity: they mainly enable users to delocalise software development activities in order to benefit from cheaper labour costs. This delocalisation is

implemented either by placing temporary staff on sites situated off-shore or by using on-line satellite or terrestrial communication facilities to transfer software.

Large-size user corporations are becoming increasingly aware of the competitive advantage they can obtain from the existence of consulting and programming resources based in their foreign subsidiaries. In Europe, this trend is facilitated by the lowering of trade barriers which enables an easier flow of services across borders. Although the off-shore programming market is still in its infancy in many respects, it will certainly become an effective alternative to high-cost internal programming as pan-European data exchange networks facilitating off-site services are built up, and user organisations increasingly integrate internationally. In Scandinavia, off-shore programming is already showing signs of strong growth.

The choice of off-shore programming will depend to a certain extent on the trade-off between this service and alternatives, such as the use of CASE tools (which, in the long run, generate considerable development cost savings), or the use of cheaper human resources in other geographical areas, taking into account all of the technical difficulties that this implies in communication or development methods.

Finally, a major market opportunity is emerging in application maintenance services. Users are becoming more and more conscious of the value of their applications portfolio and are confronted with increasingly technological issues (for example, open systems and networking) that encourage their demand for application revamping and migration. Packaged software vendors are also rapidly developing their supply of maintenance services as packaged software kernels are associated with customisation services.

5.2.3. Education and Training Services

The education and training market now represents an important part of the European professional services market. It is extremely fragmented, having been entered by many small-sized vendors of different kinds: VARs, distributors and users, together with independent software and traditional systems vendors.

Systems vendors are the largest providers because they control hardware, and systems and utilities software technology. Independent vendors are increasingly realising the potential of the market, as well as its logical interaction with IT and management consulting projects. Users, once extremely loyal to systems manufacturers for their training needs, are gradually seing independent software vendors as an alternative. The spread of open systems and multiple-vendor hardware installations are accelerating this trend, making vain any "a priori" preference for a link with a specific vendor.

The training market is highly unstable: users are extremely price-sensitive, and are easily prone to postpone or even cut education courses when DP budget constraints become too tight, making it difficult to manage timetables and workloads.

To confront this problem, more "customised" courses are emerging as a less expensive and more efficient alternative. At the same time, courses are becoming more technically specialised and aimed at addressing issues such as networking or heterogeneity problems (although the bulk of the market is still made up of basic technical courses: programming languages, systems and applications). More advanced issues such as client/server computing and CASE, though still representing an extremely small share of the market, are getting higher coverage.

5.2.4. Systems and Network Operations (Facilities Management)

Intended as the management of systems and network operations, facilities management (FM) is the fastest growing segment in the professional services market.

Two kinds of service providers are prevailing in the industry:

- companies with enough financial and technical resources to provide services on an international basis;
- and localised small-sized players, addressing particular vertical markets on a national scale.

Very different levels of development exist in the different European countries. The UK stands out as the largest market, due to the traditionally more positive attitude of UK users now nurtured by a very strong offer from both local and international FM service vendors. The increasing number of players and the consequent strengthening of offerings has helped growth in these services in France, which is now the second largest market in Europe. On the contrary, the German market is lagging behind as user organisations are still very keen on maintaining a high degree of control over their information systems.

In most other European markets, the prevailing model is that of small contracts, usually involving the management of non-strategic applications. Full FM contracts lasting up to ten years (such as those sometimes adopted in the US) are still extremely rare in Europe.

The competitive environment in this segment is being reshaped, due to the rapid reorganisation of the players mainly through mergers and acquisitions. Equity partnership activities are basically aimed at reaching the critical business size necessary to compete with US companies.

Overall, the FM business is growing, helped by the push of the players who are putting more effort into it as:

- a strategic complement to any full-pledge strategy by service vendors;
- a major component in the rapidly developing systems integration area;
- a potential market helping penetration in Europe, especially for US vendors (the future of the Japanese FM giants in Europe still requires clearer strategic definition).

5.3. Systems Integration

The systems integration business in Europe was worth some 5 billion ECUs in 1992. Germany is the largest market; together with France and the UK it makes up over 70% of the European market.

The finance/insurance sector is the most important vertical market addressed by this kind of service, followed by manufacturing and government (mainly central government).

Business change is driving the growth of systems integration: factors such as mergers and acquisitions, moves towards a single European market, the recession and growing pressure on margins, increasing competition and deregulation are all compelling companies to change the way they run their businesses. This causes organisations to re-think the way that IT works for them. From a technical point of view, the result is that user organisations require increasingly complex systems, but find it more difficult to generate internally the skills necessary to manage and operate them.

Growing user demand for outside systems integration intelligence and risk-commitment is being increasingly addressed by traditional systems vendors. Slow growth and shrinking

margins in the hardware market are encouraging them to focus their offering mix on services (systems integration in particular) where they can still value-price their activities and meet profit targets. The hardware component of systems integration contracts is remarkable: computer and communications hardware and systems support revenues make up just over 40% of the European systems integration business.

But the evolution of the market is towards a relative increase in the share of services at the expense of computer hardware. Hardware vendors will therefore also have to develop business and consultancy skills, in line with software and service suppliers and the large consulting practices.

Flexibility is the key success factor for all of the players operating in this business, especially in Europe. They need to consider subcontracting, as well as partnerships and consortia (either with companies that are normally seen as direct competitors, or with small local vertical oriented sub-contractors).

6. Conclusions

The complexity of the European situation is linked to the fact that trans-national trends affecting the worldwide market are combined with country-specific evolutions linked to market conditions (regulations, cultural factors, industry structure, government policies).

6.1. European Integration

The integration of European markets, a unified currency and no trade barriers will lead to further complexity in the outlook of the possible evolution of the market. Although this may cause certain difficulties, it also represents an opportunity for the integration of European companies under the spur of federating poles.

A segmented view of these implications is necessary because they vary considerably from user to user and player to player according to size and strategy (internationalisation, product/service offerings and the types of investor involved).

User Needs

Users will need to modify their strategies to adapt to the new economic environment, and software houses have clearly identified this as an opportunity for their business. Furthermore, users will become more eager for EC-adapted products and internationalised services; European coverage on the part of suppliers will become a major factor of preference in the selection process. This is certainly good news for the companies already well-advanced in their internationalisation plans, but a challenge for the ones that are just starting.

Customers doing business in markets which are still regulated and protected (such as banking and finance, or telecommunications) will face the toughest challenges, and a lot of market reorganisation is expected in these sectors; this will spur the demand for IS reorganisation projects. On the other hand, fewer changes are expected in the Public Administration and manufacturing sectors, which already have a highly integrated environment (production methods like MRP II are used worldwide).

Large International Groups

The larger European groups are already aware and ready to confront a unified European market, their existing global operations allowing them to anticipate the rules and consequences of a united Europe. US vendors are also ready to face European integration because, entering the European market from outside, they have always identified and addressed it as a whole.

Nevertheless European integration will have an impact on certain management aspects of large companies. A single market, unified currency and the possibility for users to purchase software and services at the cheapest price wherever they are marketed in Europe are all factors with major implications for strategic change. They will oblige companies to revise their pricing strategies, accelerate the availability of multiple language products, invest resources in EC standard compliant packages (for example, accounting software) and boost their business development strategy to acquire the capability of providing services to their clients throughout the whole Community.

European Vendors

In this very rapidly evolving context, European software and service vendors are going to have to meet new challenges from non-European competitors and the emergence of a demand for new products and services. The key guidelines that can be singled out are the following:

- the traditional relative weakness of European companies in terms of products (especially systems software and utilities) has been balanced by some major successes in the application tools and application solution sectors;
- European competitiveness remains high, both at local and at international level. There are many examples of companies which have proved themselves capable of establishing both local and worldwide leadership in the provision of comprehensive software environments, as well as a unique IT source and support interface.

6.2. European Market Potential and Directions

The European industry has enormous potential: it incorporates a large number of companies varying in size, market coverage and in-depth technological and vertical expertise, although it is inhibited by the prevailing average size of these operators which limits investment and distribution capabilities.

Despite the emergence of medium-sized companies, it is expected that the majority of European solution vendors will remain focussed on niche markets. This will certainly provide them with a certain level of security as local specificities as well as close relationships with their clients will protect them from the competition of larger vendors, at least in the short term. Nevertheless, there is a likelihood that the larger companies will eventually redirect their strategy towards medium and even small sized accounts, revealing the limitations and constraints of niche strategies.

Non-IT related players will also play an important role in the evolution of the European software and services market. Companies operating in such different sectors as banking, manufacturing and distribution are gradually building up important participation portfolios in the industry. This will provide software and service vendors important investment capacity as well as the possibility of new markets.

The push of telecommunication carriers and manufacturers will be fundamental because they can position themselves as alternative supports for the European software and services industry.

An increasing inter-penetration of the local software and services industries is expected through external growth operations aimed at enhancing their presence on selected areas in the international market.

In this sense, domestic players in the smaller markets (in terms of value) will certainly face more difficulties than others. Their market base

may be too small to foster the development of sizeable local competitors and there is a risk of a certain loss of independence in the supply of software and services.

Nevertheless, factors such as cultural peculiarities as well as the fact that some companies are still at the beginning of the integration process (Austria, Switzerland) will slow down external penetration in some areas, and others have consciously chosen regional integration models (like Scandinavia) in preference to full-scale Europe-oriented strategies.

European software and services vendors are expected to focus more intensively on the faster growing segments, such as facilities management. This focus is characterised in Germany by the acquisition of companies and DP shops in order to extend the client base, and in France by reorganisation and acquisition activities.

Mergers and acquisitions will continue as the stronger European players continue their efforts to attain the minimum critical business size which will help them to compete at an international level.

New rules of competition are also emerging in the market environment, generating new demand both in terms of additional business for the current offer mix and in terms of the new business related to the new kinds of applications the users require. This new market potential will contribute towards the lowering of entry for new software and services start-ups.

Additional growth for the current offer mix is related to many factors:

- the process of re-industrialisation of the Eastern markets increases user needs for professional services and education;
- the integration of European markets increases user needs for more skilled and effective integration capabilities at all levels;
- EC efforts to implement a "European Nervous System" to address the need for a unified telecommunications and IT infrastructure also promises growth opportunities for the systems integration business;
- the obsolescence of the current installed base, as a result of the cautious purchasing attitudes of the past, makes it more urgent to change to better platforms and the new applications that such a change would allow;
- price erosion in the field of hardware products will lead to more technical requirements, and encourage users to shift more financial resources to software applications and services that guarantee greater return on IT investments.

This last point also relates to the new types of applications and consulting activities that users require. The concept of a protected or captive market is losing ground as it is becoming increasingly difficult for a user to rely on one single source of supply capable of satisfying his more technological needs and his requirements of geographical coverage at a sufficiently low price. At the same time, it is becoming increasingly more important for him to reduce "time to action" and increase the quantifiable value of performance for the organisation as a whole.

The regulatory factor will facilitate this trend. In the Public Sector, for example, EC regulations are making it increasingly difficult to protect local administration markets. Furthermore, the DP needs of Public Administration are profoundly evolving: public authorities have got over the first hardware-oriented equipment phase, and now need more elaborate DP systems where software sophistication becomes a key issue. This also means that there is a lot of scope for EC and national Governments to be able to support the industry during this process of reorganisation.

Hannover 16.–23.03.1994
8.–15.03.1995

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The Information Technology Markets of Eastern Europe

1. A Market in Transition

1.1. Fastest Growing IT Markets in the World

The ongoing transition of Eastern Europe's centrally planned economies to market-based systems has revolutionised the development of the region's information technology (IT) markets. Most importantly, trade liberalisation, customs reform and the demise of state-owned IT organisations in the wake of company restructuring and privatisation have produced fundamental changes with respect to IT sales, marketing, the level of local vendor competition, and the composition of the client base. Reform has also facilitated the complete transformation of distribution channels and the emergence of hundreds of small, private firms conducting IT-related operations throughout the region.

Today, economic reform and the small size of the average Eastern European market have made this region the fastest growing IT market in the world, despite the myriad of difficulties entailed in the reform process. *Figure 1* illustrates that IT hardware Compound Annual Growth Rates (CAGRs) for the Eastern countries far exceed the combined average of 1.7 percent for the markets of Western Europe. Indeed, the need to

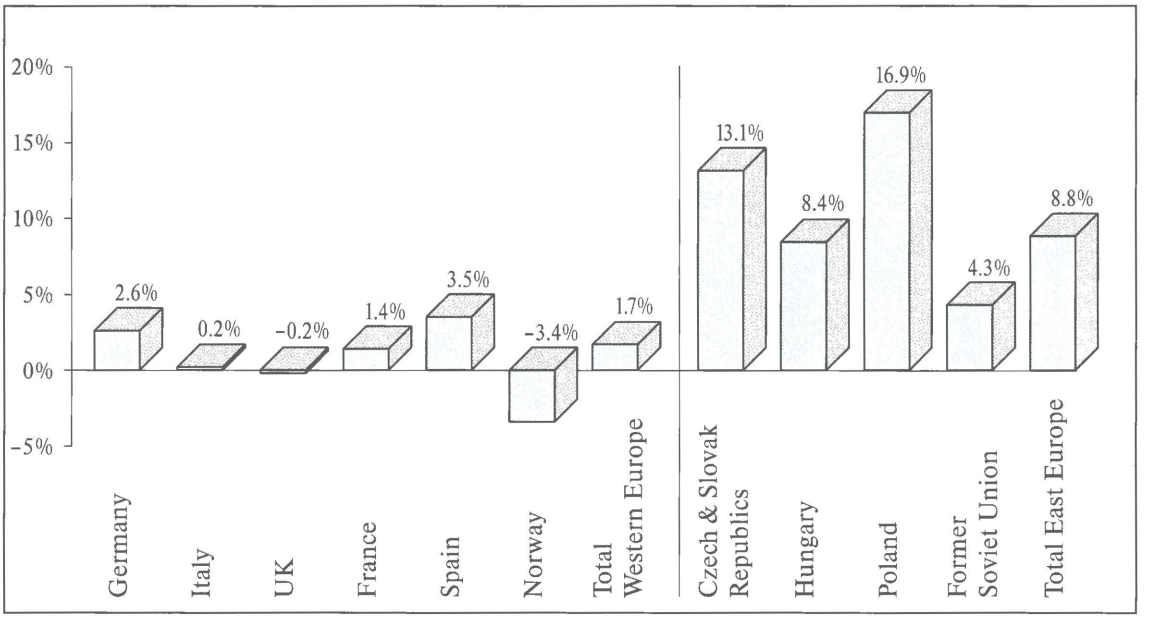
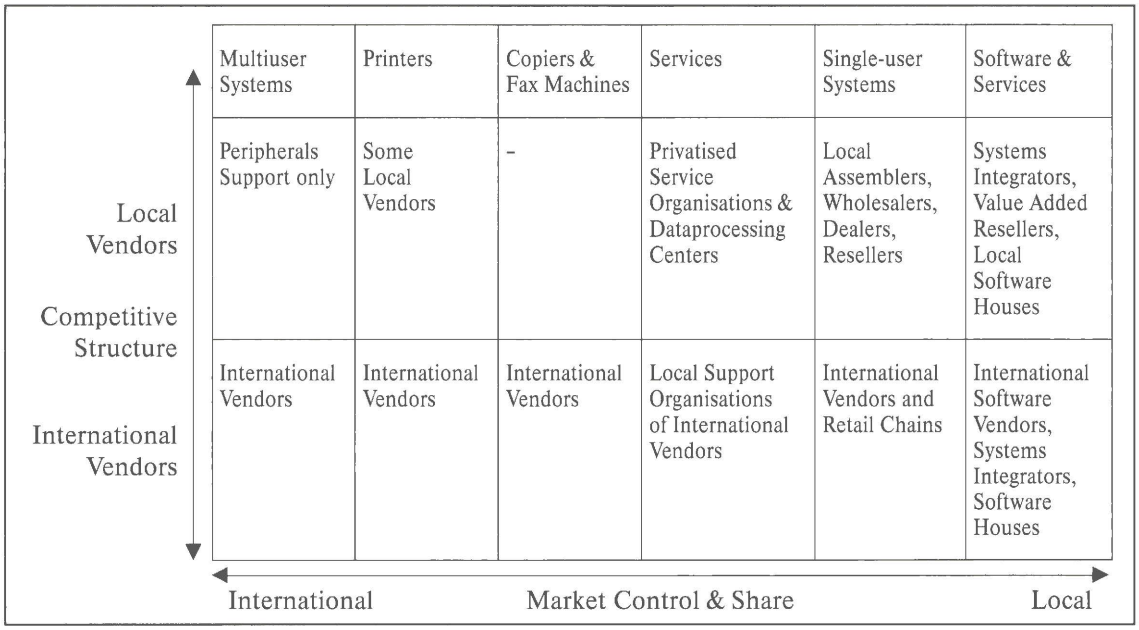


Figure 1
East versus West: Compound Annual IT Hardware Spending Growth Rates, 1991-1994

Figure 2
Structure of the Information Technology Market in Eastern Europe, 1992



modernise industry as well as a broad range of basic services such as banking, insurance and government administration will drive strong IT hardware market growth throughout Eastern Europe well into the latter 1990s.

1.2. The Structure of the IT Market, 1992

The virtual collapse of the former Council of Mutual Economic Assistance's (CMEA) computer industry by 1990 along with foreign trade and customs reform opened the way for penetration into the once closed markets of Eastern Europe by outside vendors. *Figure 2* delineates the current structure of the region's IT markets in the aftermath of their exposure to outside competition. International vendors now fully control the dynamics of a number of technology markets such as multiuser systems, printers and office equipment. They have also made significant inroads into the markets for packaged software, and software and services.

The entry of highly competitive, better organised and financed international IT vendors quickly forced the remnants of the region's obsolete computer industry to the fringes of the IT market. Consequently, local state-owned IT organisations have either terminated operations or turned to low cost personal computer assembly, software development and distribution, and IT maintenance and dataprocessing services. The demise of the Eastern Europe's state-owned computer industry also released a number of IT personnel to the new private sector, which now encompasses the most dynamic IT firms to be found in the region. For example, local private firms represent the leading contendors in personal computer markets, accounting for as much as 80 percent share in some countries. They have also become important players in software and services, functioning as vendors and distributors of packaged software, value-added resellers for international vendors, and systems integrators for large-scale tenders.

The transformation of Eastern Europe's centrally planned economies into market-based systems has fundamentally altered IT distribution in the region. The reform of state controlled distribution had already begun by the early 1980's when the Hungarian and Polish governments decentralised planning, management, and procurement in the IT industry. Even then, some official organisations retained long-range planning and coordination functions for overall IT development. Nevertheless, a precedent had been set which mandated that direct state supervision of the electronics industry and distribution was to be gradually eliminated in the wake of trade liberalisation and the introduction of private enterprise and other free market forces.

Economic reform, in conjunction with the large number of foreign IT firms which have entered the Eastern Europe since 1989, have accelerated the transformation of local IT distribution. Most importantly, this period has seen the expansion and refinement of channels through the establishment of multi-tiered third-party agreements, encompassing dealers, value-added resellers, systems integrators and local outlets. This development has led to an initial polarisation in the region's markets between the once predominant state-owned IT companies and local assemblers and those international vendors which have signed on local firms to pursue value-added strategies. Compounding this trend is the increased sophistication of local and international distribution chains, which, by acting in alliance, are squeezing less competitive players out through high-volume purchases and lower retail prices.

Today, IT distribution in Eastern Europe largely reflects the important role that vendors of single-user systems, small-scale systems and PC-related technologies play in the market. The current regional channel infrastructure for IT distribution involves six key forces:

1. *Large, Local Systems Houses:* The fortunes of the leading local system houses have had a major influence on the evolution of IT distribution in the region. Such local firms are distinguished by their wide-ranging distribution capabilities. Aside from maintaining networks of resellers and outlets, each firm can act individually as a personal computer assembler, a components manufacturer, a dealer or distributor for a major brand-name vendor, and a customised software provider. Moreover, they are oftentimes securely leveraged in other value-added activities, or in businesses such as car leasing or health services.

The importance of local system houses in IT distribution can be gauged by their relations with international vendors seeking to their position in the market. Usually, such local companies will be granted an exception to the exclusivity rule in reselling vendor platforms. Whereas a dealer in Western Europe may be restricted to retailing the systems of one particular vendor, Eastern European firms are often not subject to such limitations, despite possible conflicts of interest.

2. *International Multiuser and Personal Computer Vendors:* One of the most important factors defining the parameters of current IT distribution in Eastern Europe has been the entry of international vendors into the market. International vendors are able to plan and implement distribution strategies based on experience, back them with considerable financial support, and provide complex solutions based on a variety of products with established reputations. Understandably, market entry has been accompanied by distribution strategies and policy approaches focused on the creation of distribution structures mirroring those found in Western Europe.

One of the most significant challenges for direct selling by international vendors stems from the large number of second-hand resellers now active in the Eastern European markets. More than a dozen companies and so-called brokers are currently reselling second-hand from major international hardware manufacturers. The leasing of second-hand equipment is another option which has gained popularity among price conscious end-users in the region. Since 1989, a number of firms from Germany and Austria have been leasing used mainframes in the local markets, sourced in Western Europe.

3. *Systems Integrators and Value-added Resellers (VARs):* Distribution agreements with international vendors have the impact of legitimising the expertise of local partners in the eyes of end-users. The third-party local firm is then able to market not only hardware and software, but also its acquired technical know-how. This enhances the reseller's capability to retail a product on the basis of an intangible value, i. e., name recognition, combined with the provision of application consultation and long-term service and support to the end-user. Such identification is an essential first step in the establishment of a vertical market strategy based on a particular value-added expertise.

4. *Local Personal Computer Assemblers/ Component Suppliers:* Local personal computer assemblers are becoming increasingly more important in the distribution channel network as a consequence of their ability to compete with international vendors. A number of Eastern European firms have developed their component sourcing and PC marketing skills with precision.

The emergence of these local firms as top PC vendors has only occurred more recently in the wake of a consolidation process among assembly operations in the local markets in the 1991–92 period. The substantial profit margins attainable with the sale of personal computers sourced from the Far East during Eastern Europe's 1989–90 PC boom (reaching 200 percent at one time) gave way to more costly components and declining profits in the wake of currency devaluations and trade liberalisation. Consequently, many firms shipping substantial quantities of personal computers were forced to end operations, diversify into other value-added IT activities, or leverage their activities with other types of business. This development allowed more versatile manufacturing/assembly operations to outlast their less secure competitors and rise to the top.

Two of the essential characteristics of surviving firms have been (1) volume sourcing of components and (2) refinement of distribution and marketing skills. Volume sourcing, which ensures the procurement of components at inexpensive prices, has led local companies to develop franchise dealerships and adhoc dealer networks which order components on a monthly basis. This allows economies of scale to be factored into the price negotiations with Far East and Western European component distributors. By franchising, the company avoids the overhead costs of establishing its own outlet.

5. *Emerging Franchise Distributors/Retailers:* Another mark of encroaching international influence on IT distribution in Eastern Europe is the genesis of a Pan-European franchise dealer/ distributor chains. Most major franchise chains were present in some form in the region by 1991, either through a local subsidiary or distributor.

One immediate impact of the presence of chains is a market constriction for local VARs offering only networking installation experience and no-name PCs. In theory, franchise networks have an ability to deal in high volume which facilitates competitive pricing. This should enable them to drive out East European players at every link of the distribution chain, i. e. supply, distribution, and retail of components, peripherals,

and complete systems. In practice, however, such firms are finding it difficult to compete with local PC assemblers/component distributors. Local end-users can already purchase the name-brand PCs such franchises retail through existing firms.

6. *Commodity Exchanges:* Unique to the region, IT distribution in the republics of the former Soviet Union is dominated by assembly operations, commodity exchanges and black market channels selling directly in the market. Commodity exchanges trading PCs in volume have formed in several major cities, including Moscow, Leningrad and Riga. Indeed, exchanges exist for a number of IT products, e. g., the Intellectual Property Exchange in Leningrad which trades licenses, technical drafts and technical projects. Another organisation, called the Moscow Technologies Exchange (MTE), was formed by the Moscow Aviation Institute, the Moscow Bauman Technical University and the Russian Ministry of Agriculture, for the purpose of bringing together technology developers with factory owners seeking new innovations. One of the largest trading organisations was founded in November 1991 at the Moscow Commodity Exchange, which was developed through the association of several of the most reputable and well-known resellers and distributors of computing, communications and microelectronics technology in the market.

2. IT Hardware Market

2.1. East versus West – IT Hardware Market Sizing

One source of market potential is encompassed in the current size of the region's IT hardware markets. An analysis of IT expenditures in Eastern Europe reveals that overall hardware spending still falls far short of the average country market of Western Europe, despite extensive programs for the revitalisation of IT infrastructures. In fact, the estimated ECU 1.16 billion spent on IT hardware in 1992 in the Czech and Slovak Republics, Hungary, Poland and the former Soviet Union depicted in *Table 1* rivals expenditures only in some of the smaller IT markets of Western Europe, such as Austria and the Scandinavian states. This figure also comprises less than one tenth of the ECU 14.6 billion in IT hardware expenditures attained last year for Europe's largest market, Germany.

	1991	1992
Poland	230	264
Czech & Slovak Republics	243	264
Hungary	257	251
Former Soviet Union	703	387
Norway	1,220	1,113
Austria	1,223	1,220
Netherlands	3,365	3,247
Spain	4,122	4,193
Italy	6,212	6,134
United Kingdom	10,054	9,426
France	10,235	9,975
Germany	14,690	14,600

Table 1
East versus West: Country Market Comparison of IT Hardware Spending (ECU Millions)

An examination of the ratio of IT spending to Gross Domestic Product (GDP) provides another indication of market growth potential derived from the size of the region's IT hardware markets relative to those of Western European countries. Despite years of socialist-inspired claims to the contrary, spending levels on IT hardware in the East have been well below the rest of Europe. A comparison of IT shipment and

GDP data in *Table 2* demonstrates this point. Whereas the ratio of IT spending to GDP in 1991 averages around 1 percent for select Western European countries, average spending for the former CMEA states falls consistently short of this figure with the exception of Hungary. Thus far, it appears that the economic reform process has had only a minor impact on increasing overall expenditures for IT hardware in the region, at least in the short term.

Table 2
East versus West: Ratio of IT Hardware Spending to GDP

	1991 in %
Former Soviet Union	0.04
Czech & Slovak Republics	0.25
Poland	0.29
Hungary	0.92
Italy	0.56
Austria	0.75
Spain	0.78
France	0.85
Germany	0.96
United Kingdom	1.05
Netherlands	1.18

Table 3
Value of Hardware Shipments (ECU Millions) in Eastern Europe

	1991	1992	1994
Poland	230	264	401
Czech & Slovak Republics	243	264	351
Hungary	257	251	328
Former Soviet Union	703	387	797
Total	1,433	1,166	1,877

2.2. IT Hardware Market Sizing within Eastern Europe

The impressive long-term growth within the Eastern European region as a whole masks the strengths and weaknesses of the individual markets on their own. A brief comparison of relative market sizes and the status of economic reform programs reveals some unique characteristics of each country-market.

Although the *former Soviet Union* stands out in *Table 3* as Eastern Europe's largest IT hardware market in 1992, with 33 percent of the region's ECU 1.16 shipment value, total expenditures were far less than the ECU 1.11 million reached in the Norwegian market. The quagmire of protracted economic and political reform sharply reduced hardware spending in the 1991-92 period. Indeed, this regional market contracted by over 50 percent from 1991 to 1992.

With the second largest IT hardware market in 1991, Hungary has evolved as a standard of maturity and sophistication in the developing IT markets of the Eastern European region. Today, almost every major international IT company is represented in this country market, from software vendors to chip manufacturers. The IT market has also witnessed the early development of distribution channels and the introduction of third-party distribution strategies which mirror structures in Western Europe.

With one of the region's highest levels of industrialisation and lowest levels of foreign debt, the former *Czechoslovakian Federated Republic (CSFR)* has emerged as the market with the greatest growth potential over the long term. Although the ECU 264 million spent on IT hardware in 1992 makes this market one of the second largest among the countries examined in this survey, it is decidedly unique in terms of the

type of balanced market growth taking place in all hardware categories. For example, the number of multiuser systems shipped into the former CSFR in 1992 almost matched the combined total for Hungary and Poland, while exceeding that of the former Soviet Union.

Despite a deep economic recession and a sharp decline in industrial production, the IT hardware market in *Poland* prospered in 1992 as a consequence of remarkable growth in the demand for personal computers and printers. The value of IT hardware shipments reached an estimated ECU 264 million, marking a twofold increase over 1990, with personal computers and peripherals comprising over 80 percent of this total.

2.3. IT Hardware Category Comparison

As demonstrated in *Table 4*, two hardware categories in Eastern Europe gained rapidly in value over the past two years, while a third experienced a market value consolidation. Shipments of single-user systems and PC-related technologies have maintained the overwhelming percentage of value in comparison to all other hardware categories. The printer and office equipment segment, described in the "Others" category, has seen considerable market growth. In contrast, the multiuser market has conceded more than 10 percent in value to the other two sectors. Growth in this sector in 1992 has constricted slightly in comparison to the previous year due to ongoing economic reform, privatisation and company restructuring. Nonetheless, this is expected to be only a short-term dynamic, as long-term growth in multiuser market value is projected. The total value of hardware markets in the region effectively decreased by approximately 19 percent in 1992, largely as the result of a sharp fall in multiuser shipments in the markets of the former Soviet Union.

	1991 in %	1992 in %
Personal Computers	48	48
Multiuser Systems	23	12
Other	29	40
Total Value (ECU million)	1,432	1,166

Table 4
Eastern Europe: IT Hardware Value Category Comparison

2.3.1. Single-user Systems Market

Extraordinary growth has been the hallmark of the Eastern European personal computer markets since 1989, with over 90 percent of the region's current installed base shipped over the past three years. With an estimated compound annual growth rate exceeding 20 percent, over 525,000 units were supplied to the region (excluding Albania, Romania, Bulgaria and the states of the former Yugoslavia) in 1992. Total market value for the same year reached ECU 522 million, with the former Soviet Union accounting for just over a third of this amount. The discrepancy of a short-term value decrease compared to the 1991 figure of ECU 651 million will not significantly inhibit projected long-term growth.

The personal computer markets of Eastern Europe are relatively small in comparison with other European country markets. In fact, the number of personal computers supplied to the region in 1992 (the Czech and Slovak Republics, Hungary, Poland and the former Soviet Union) rivaled that of the Netherlands with 544,000 unit shipments. The same figure for Eastern European represents only one-fourth that of Germany's for the same year.

The stark contrast between statistics comparing Eastern and Western Europe obscures some important differences among markets in the East. The former Soviet Union represents

the region's largest IT environment with 210,000 professional PCs shipped and 1.14 million installed in 1992. Although the projected demand for PC technology among the fifteen former republics has been widely heralded, most end-users do not have the financial resources to make significant purchases in the near term. Indeed, far fewer single-user systems were shipped in 1992 than in 1991, mainly due to economic difficulties and political instability. Overall, the marketplace of the former Soviet Union in 1992 was severely constricted which should continue until the process of political and economic reform begins to stabilise.

Hungary and the former Czechoslovakia, whose PC markets grew by substantial margins in 1992, provide useful examples of contrasting trends in the buying preferences of Eastern European end-users. The market in the CSFR flourished, with new system shipments reaching 118,000 units, an increase of 23 percent over the previous year. In Hungary, professional personal computer shipments escalated to 85,000 units. Local assembly operations have traditionally served as the largest source of shipments in both countries. Indeed, clone assemblers accounted for as much as two-thirds of total PC sales in Hungary from 1989–92, and an even higher percentage in the CSFR. Nevertheless, it is possible to discern an increasing level of IT sophistication among Hungarian end-users, suggesting that international PC vendors may be able to gain market share against local clone dealers.

This conclusion is derived from evidence of increased brand-name PC shipments and impressions received from local dealer interviews, which indicate an end-user willingness for service and support and other value-added services normally provided only by brand-name dealers. One factor supporting the viability of this trend is that price concerns are less of an issue in Hungary than in other countries in the region. Indeed, average system values for personal computers in this country market tend to be twice as high as those in other Eastern European countries. Hungary is such an exceptionally high-priced market that the value of the personal computer market in 1992 exceeded Poland's despite fewer PC shipments. In contrast, Czech and Slovakian end-users neither share the strong tendency towards purchasing name-brand machines, nor are they willing to pay more for their systems.

In Poland, annual growth in system shipments increased sharply, due in part to a continuing reduction in average system values and volume PC purchases by end-users in the face of proposed reforms of customs tariffs. In 1992, the number of professional single-user systems arriving into the Polish market rose by 24 percent over the previous year, reaching an estimated 112,000 unit shipments.

Despite generally increasing shipment figures by brand-name vendors in the region, assembly operations continue to determine the dynamics of the Eastern European markets. For example, the three leading local assemblers in Poland have supplied the majority of single-user systems shipped in 1992. In 1991, international vendors did appear among the top ten vendors for the first time in the history of the Polish PC market, even though their combined unit shipments accounted for less than a 20 percent share.

Overall, the single-user system market has undergone a complete transformation over the last two years in terms of players, distribution, technology, and pricing. The former Czechoslovakia, for example, was previously a small, closed market dominated by a few local assemblers of non-brand equipment working closely with state distributors. The local IT arena now contains a plethora of companies engaged in computer re-

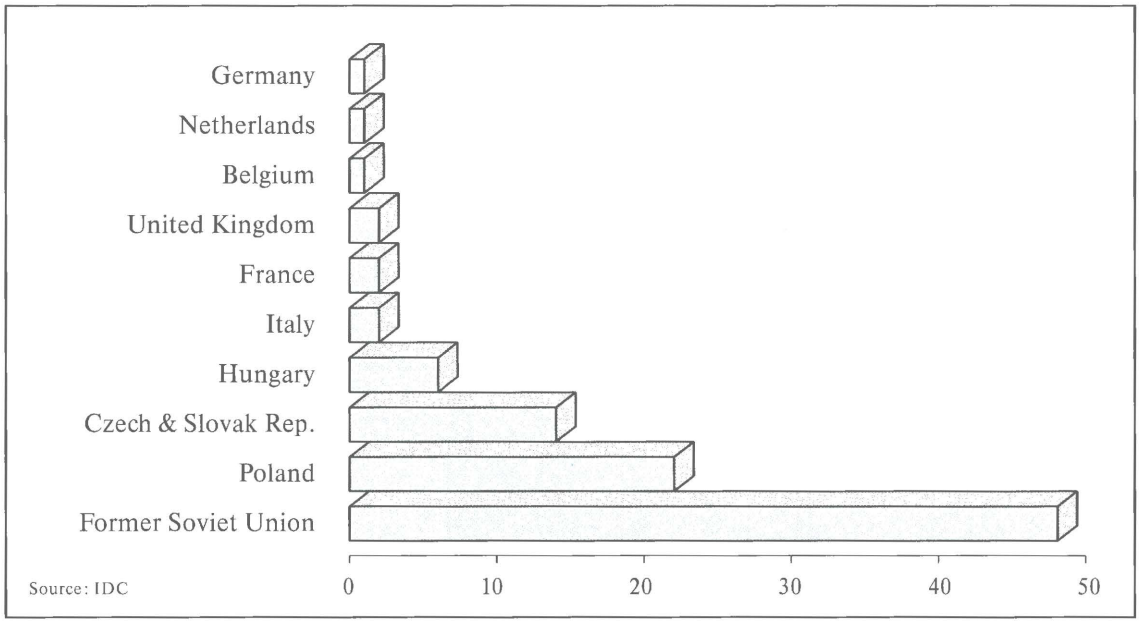


Figure 3
East versus West: White Collar Workers per PC Installed, 1991

lated activities, estimated to number over 1,200. Currently, the personal computer market has reached a saturation point in terms of players in Poland, the Czech and Slovak Republics and Hungary. In the future, market growth will continue in these countries, albeit at a more predictable pace. The possible exceptions to this predictability rest in the emerging markets of the former Soviet Union.

Annual growth in shipments through 1994 is expected to exceed 20 percent, which is far greater than any other region in the world. Substantial growth will also take place in the installed base, with approximately 4.75 million personal computers to be found in place in the region by 1994. The value of PC shipments in Eastern Europe will attain an estimated ECU 881 million by 1994, with the former Soviet Union accounting for half of this amount. Due to decreasing PC prices, however, the increase in the value of shipments will demonstrate a CAGR of only 9 percent.

Evidence of the considerable pent up demand for personal computers throughout the Eastern European economies can be gleaned from comparing the number of white collar workers to PCs installed, illustrated in *Figure 3*. Whereas one to two PCs are installed for every white collar work in Germany, the United Kingdom and the Netherlands, the corresponding figures for the Eastern European countries range from one for every six workers in Hungary to one for every forty-six in the former Soviet Union.

Many of the newly decentralised or privatised firms that have emerged over the last two years are overwhelmingly oriented toward the application of single-user machines in their everyday operations, with LANed personal computers slowly becoming their platform of choice. They are prime candidates for batch PC shipments bundled with software applications and networking. Consequently, the evolving private sector will serve as the locus of personal computer

system market growth in the years ahead, particularly small companies with between 10 and 200 employees. Moreover, public sector administration will spur the demand for shipments of this size class. State agencies such as Post and Customs Offices, and National Police are still not sufficiently equipped with personal computers and constitute a potentially large market. Growth will also be recorded in the laptop and notebook arena as a result of the overall improvement in single-user system shipment market.

The sharp increase in shipments of 80386/80486 processor-based systems over the last two years has been accompanied by a corresponding rise in the file server-based computer networks. Almost fifty percent of all personal computers shipped in the region (excluding the former Soviet Union) last year were networked.

The number of networked personal computers can be expected to increase in the coming years, due to the growing popularity of such technology across Eastern Europe. Indeed, LANs, which combine the inexpensiveness of PC technology with the power of a distributed computing environment, are already becoming the configuration of choice for cash-strapped end-users unable to afford multiuser systems. Opportunities for LAN shipments exist in the education, banking, insurance, education, manufacturing and financial services sectors. Local file-server and enterprise-wide networks represent the most common client server configuration.

An authentic technical workstation market in Eastern Europe has only emerged within the last year with the recent relaxation of CoCom restrictions and the initiation of operations in the region by a number of international workstation vendors. Some 1,805 technical workstations were shipped in 1992 in Eastern Europe, representing a combined market value exceeding ECU 22 million.

2.3.2. Multiuser Systems Market

Large-scale public infrastructure projects financed by the World Bank, the European Bank for Reconstruction and Development (ERBD) and the European Community (EC) have fueled substantial growth in the multiuser markets of Eastern Europe, which are now fully under the control of international vendors. In 1992, hardware shipments to the Czech and Slovak Republics, Hungary, Poland and the former Soviet Union reached roughly 2,100 systems, for an estimated market shipment value of ECU 138 million.

This figure was down considerably from the ECU 323 million obtained in 1991, due to demand and supply side difficulties within the former Soviet Union. Whereas the value of shipments actually increased in other countries of the region, particularly in the Czech and Slovak Republics, economic instability, compounded by the ongoing restructuring of large former state organisations, strongly undermined multiuser procurement and financing in the former fifteen republics. The demise of the indigenous computer industry also contributed to a sharp reduction in the supply of new machines priced in roubles.

Strong multiuser growth forced most international vendors to reorganise and step up their operations in Eastern Europe in the 1991–92 period. Major market players have moved from local representative offices, for sales and support, to direct operations conducted through wholly-owned subsidiaries. Many other companies have sought to strengthen their local presence with the establishment of country-wide distribution and service networks, signing on local firms to serve as distributors, value-added resellers, and dealers.

One notable development in this market segment is the growing emphasis on vertical market strategies. Relying upon their success in other country markets, some vendors have concentrated their marketing and sales efforts on isolating financially solvent market niches, usually with the assistance of local partners. In winning several tenders in one sector, vendors have begun to make their product offerings synonymous with that area of expertise, which some have done in the banking and financial services industry in Eastern Europe.

Another visible trend in this market is the growing emphasis placed on consulting, software development, applications, and systems integration, whereby hardware vendors are drawing upon the services of local software organisations, or those of outside software houses. In some cases, large-scale systems integration projects for government administration and banking are being directly supported by software houses from Western Europe. Local software organisations have also begun to play an important role in providing local project development and customised software support to computerise public facilities, local banks and health services.

Although Eastern Europe's multiuser market is expected to decline significantly in the years ahead in terms of shipments, value and installed base, this dynamic is largely related to the fortunes of the CIS and Baltic state markets. Hungary, Poland and the Czech and Slovak Republics will exhibit growth rates exceeding 30 percent in the value of mainframes and just under 4 percent for small-scale systems between 1991 and 1994. Despite stronger growth rates at the high end of the market, most shipment activity will be confined to the small-scale sector, i. e. small proprietary systems, Unix-based machines, network servers, and multiuserbased client server configurations. Due to high retirement rates of outdated CMEA equipment, the installed base of multiuser computers is anticipated to decline by an average of 3 percent annually over the same period for the region as a whole.

2.3.3. Is There Mainframe Replacement Potential?

One of the most important questions for outside vendors today in Eastern Europe is the replacement potential represented by the installed base of mainframes and minicomputers manufactured by the former CMEA. In view of the average age and performance characteristics of Ryad and SM systems, the ratio of CMEA to Western illustrated in *Figure 4* suggests that a very large potential does in fact exist. Many vendors appear to think so as well, when considering the various marketing/sales schemes that have been implemented in the region, including discounted buy-back programs, upgrades supplemented with inexpensive operating systems and hardware, and compatible localised product offerings.

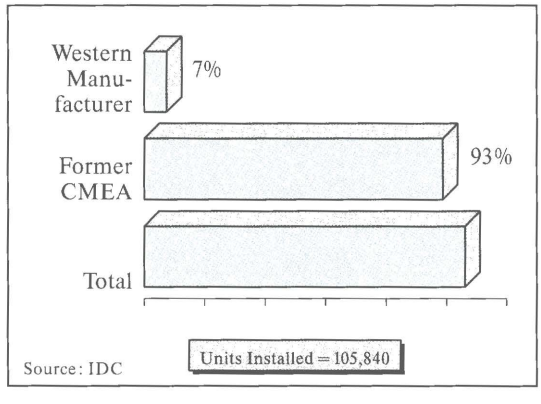


Figure 4
Multiuser Replacement Potential? Source of Installed Base Comparison, 1991

Nonetheless, this potential is largely overstated when considering the impact of the privatisation and enterprise restructuring process on the status of the many state-owned data processing centers which can be found in industrial associations and state companies throughout the region. One development which is strongly

undermining replacement potential is the widespread dismantling of DP centers due to restructuring, the ensuing loss of DP clients, and a curtailment of financial support from the government. An increasingly common result of enterprise reform is that many newly decentralised companies are implementing their own IT strategies to meet data processing needs rather then rely upon the services provided by the DP centers of their former combines. Once enterprises have taken this step, the cashstrapped DP center, with its obsolete, unreliable mainframe, performing batch-processing, is left with little choice other than to cease operations and discard its system, or diversify into other IT activities.

Aside from DP centers in sectors such as insurance, social security, banking, energy, and finance, where the DP center will continue to function as a focal point for data collection, exchange and processing, the majority will be unable to survive over the next two years without new outsourcing clients or DP projects from the government.

In those cases where the decision has been made to replace the system, it usually takes one of three forms: upgrading, the purchase of a second-hand mainframe, and downsizing or rightsizing to a new system.

Upgrading CMEA machines to a new system is one option, albeit the most competitive. Some international vendors possess a clear tactical advantage here because of the local IT community's familiarity with their proprietary architectures, which formed the standards adopted by the former CMEA in its joint development programs for computing technology. Another upgrading possibility which is growing in popularity is the simple replacement of peripheral devices. In fact, the Eastern European market has seen the emergence of a thriving peripherals market for mainframes and minicomputers over the last two years.

Concern over price has given rise to another option which has become an equally important factor in the replacement equation, that of *second-hand systems*. Indeed, some of the strongest competition for international vendors in the replacement market is coming from Austrian and German-based resellers of used multiuser equipment, which can be obtained at prices ranging from DM 10,000 to DM 100,000. At least 55 second-hand mainframes have been shipped into the Czechoslovakian market alone since 1989.

If a DP center should stay in operation, the likely consequence is *downsizing* or *rightsizing* to a smaller machine. In fact, downsizing has emerged as probably the most important development in the replacement market where significant opportunities exist for shipments of Unix servers, personal computers and local area networks, and configurations of client-server technology. In part, this trend reflects the poor reliability and low performance characteristics of many of the multiuser systems installed, where even networked personal computers are often considered to provide better computing services than the original Ryad or SM machine. The obvious alternative then is to move to a lower end platform in order to develop and sustain more efficient operations while cutting costs.

2.3.4. Downsizing: Proprietary Systems vs. Open Systems and Unix

The real dilemma for local end-users seeking to downsize is whether to remain with proprietary hardware machines or move to open systems. Despite attempts by some vendors to capitalise upon the installed base of locally manufactured computers, Eastern European MIS professionals are largely decided on the value and importance of incorporating OSI standards into their IT strategies, as evidenced by

the large number of Unix-based OSI machines being shipped in the region. Moreover, survey data suggests that the vast majority of IT sites in the region are now pursuing some type of open systems strategy, with standard operating systems and enterprise-wide communications systems as the most common means of achieving interoperability. Nonetheless, the ongoing success of some proprietary vendors testifies that an end-user base exists in Eastern Europe for both technology approaches.

The most important factors driving the demand for Open Systems in Eastern Europe are the efforts of both Unix International and the Open Software Foundation (OSF) to promote OSI architectures and protocols. Both of the competing Open Systems technologies are well represented in the region through the local operations of their members, most of which have begun offering Unix-based OSI.

The official IT policies of some Eastern European governments have also played an important role in furthering the local acceptance of Open Systems operating in a Unix environment. For example, the Polish government's steering committee on IT development has recommended OSI standards over other possibilities on the market, in order to enhance interoperability across platforms. The organisation has specified OSI compatibility for all IT procurement for the public sector, and it maintains a strong Open Systems promotional campaign, a combination which is naturally influencing IT trends in the private sector. In this endeavour, it has selected the Portable Operating System Interface for Computer Environments (POSIX) as a standard specification for C language application portability. Although POSIX is being targeted to be the common component of Unix-based environments, it can also be used for portability across other environments. The committee also chose SQL as the standard database engine.

The IT community of Eastern Europe also has a long-standing interest in Unix as a multiuser operating system, with the first industrial applications being conducted in 1984, running on PDP-compatible small-scale machines. In fact, a number of Unix-compatible operating systems were developed in the region in the 1980s, some of which could reportedly operate on domestically manufactured IBM XT-compatible and PDP-compatible machines. Nonetheless, the application of local Unix OS was generally not very widespread due to a lack of incorporated software development tools as well insufficient peripherals to handle the storage and reliability required by processing-intensive Unix tasks.

Today, Unix is slowly becoming the predominant operating system in the multiuser markets of Eastern Europe, with the exception of the former Soviet Union. An analysis of 1991–92 multiuser shipment data suggests that over 50 percent of the all multiuser systems now going into the country markets of the Czech and Slovak Republics, Hungary and Poland employ Unix as a primary or co-resident operating system. As with Open Systems, the large number of vendors pushing Unix-based systems in the Eastern European markets has been instrumental in increasing the system's popularity.

Nonetheless, obstacles to the diffusion of Unix-based technology in Eastern Europe still abound, including the popularity of MS-DOS and LANs for single-user systems, CoCom regulations, and the Eastern European IT community's general lack of familiarity with the operating system. CoCom continues to limit the export of many workstations and high-end small-scale systems best suited for Unix OS and applications, even though Unix source code was fully decontrolled in 1991.

Although it is possible to find a number of localised variations of Unix and Xenix, based on Western copies smuggled into the region despite CoCom restrictions, much of the IT community in Eastern Europe is still unfamiliar with the operating system. The experience of many end-users of multiuser systems in Eastern Europe is limited to operating systems designed by the former CMEA, such as DOS ES and OS ES, patterned after specific Western proprietary mainframe software. Moreover, the reaction to the applications of Unix OS among end-users in some country markets appears mixed. For example, survey data indicates that end-users in Poland do not share the same enthusiasm for Unix found in the Czechoslovakian and Hungarian markets.

Finally, although the interest in Unix and Open Systems is far ranging, the local demand for such technology may be overwrought in some cases. For example, Unix-based Open Systems solutions are sometimes insisted upon in situations, where such technology is not necessarily the best solution for the applications needed, i. e. wordprocessing and spreadsheets. Nonetheless, significant opportunities do exist for Unix-based shipments though, particularly with new banks, financial institutes, and stock-exchanges, which are not tied to any particular architecture and applications, as well government administration, which is being fully reorganised throughout the region.

Despite the small installed base of proprietary multiuser systems in the region, vendors are going to find it no easier to market Unix-based systems in Eastern Europe than they have found in the West. Many potential customers are more concerned with integration and interoperability, in view of the high costs of their current proprietary machines, rather than new architectures and operating systems. Citing the limitations of Unix, others are more interested in obtaining solutions combining hardware and software applications rather than changing operating systems. However, new banks, financial institutes, and stock-exchanges, which are not tied to any particular architecture, represent strong candidates for Unix-based system shipments.

3. IT Market Opportunities and Projections

3.1. End-user IT Policies and Strategies

Information technology is slowly becoming an integral part of the everyday business operations of Eastern European firms, limited previously to state-administered, cybernetic-based concepts of computing. The most important findings concerning IT policies and strategies of user sites in Eastern Europe can be summarised as follows:

IT Strategy Development: The majority of companies in Eastern Europe continue to rely upon in-house resources to formulate information technology strategies. Nonetheless, some have recently begun to utilise independent, external consultants, particularly in the face of a lack of familiarity with many of the latest developments in IT hardware and applications.

Business Function of IT: Information technology's primary function in the everyday operations of Eastern European companies include in order of priority *(1)* accounting, *(2)* information databases, and *(3)* management information/ customer service.

IT Objectives: The most important IT strategy objectives of endusers in Eastern Europe include *(1)* reducing everyday operational costs, *(2)* improving customer service in order to enhance competitiveness and *(3)* and improving product cycle and market turnaround.

These choices indicate that end-user requirements are still at a very basic level in terms of utilisation objectives, e. g. simple applications for reducing product time, time to market, basic accounting applications, etc. Many companies are only learning to employ IT in their everyday operations, rather than to apply more sophistication, e. g. improving delivery time, customer service etc.

IT Management Issues: The key IT management issues for sites in Eastern Europe include *(1)* hardware and systems reliability and *(2)* networking capabilities.

IT Development Focus: In view of the region's obsolete installed base of computers manufactured by the former CMEA, most companies in the region will likely focus their IT activities over the next two years on *(1)* integrating central and end-user resources into a single-enterprise information system, and *(2)* migrating from older systems to more modern hardware platforms and software applications. Of course, these priorities vary somewhat by host environment. Sites with unreliable CMEA-manufactured mainframes and minis are more concerned with moving to newer platforms and applications rather than integrating their obsolete technology into a single information system. Here, the question of downsizing-rightsizing has become an important part of investment decision-making.

Maintaining Given Systems: The top three reasons offered by Eastern European DP managers for changing their systems include *(1)* improved reliability, *(2)* increased performance and *(3)* access to new applications.

Applications remain a key problem for DP managers in Eastern Europe long dependent on ASRs (the CMEA equivalent to a MIS) and other in-house developed solutions. Despite the widespread desire for improved hardware reliability, more reservations are often heard about the state of Ryad and SM system applications. However, the prohibitive costs of software will continue to force many of them to run old applications on the given locally manufactured hardware and even second-hand IBM systems.

Changing Systems: The chief reasons for not changing system platforms include the *(1)* prohibitive costs of new hardware and the need of *(2)* maintaining current applications and ensuring proper data transfer. Many survey respondents also emphasised that they were satisfied with their current systems, particularly many of the smaller companies relying upon LANed personal computers.

It is not surprising that the "cost of hardware" and the "need to maintain current applications" are most often mentioned. As pointed out below, IT development tends to be neglected in the process of company restructuring and privatisation, particularly when it comes to new capital investment. Moreover, many Eastern European firms are confronted with the problem of maintaining current proprietary applications or attempting to adapt them to newly acquired system-applications. One consequence of this dilemma is the tendency to seek out more powerful and reliable compatible hardware platforms in order to improve the performance and capabilities of the given set of applications.

Outsourcing: Despite the long history of data-processing and maintenance services provided by state-owned DP centers, outsourcing appears to have only recently begun to gain the attention of Eastern European end-users. Czechoslovakia is the only IT market where IS professionals in significant numbers are either pursuing or considering some outsourcing of data and network management operations. Software and systems development represent the functions most likely to be contracted to an outside supplier organisation.

Outside Consulting: The importance of networking to the Eastern European IT community is illustrated once again by the type of IT consultancy most local firms consider employing. Networking and business planning are two areas of IT development whereby local end-users are most likely seek outside support.

IT Staff Training: The majority of companies and organisations in Eastern Europe provide their IT staffs with a minimum of one to two weeks of in-house training, combined with a few days conducted off-site.

3.2. IT Spending Outlook

An examination of IT spending patterns among IS professionals in Eastern Europe reveals that most current expenditures are focused on maintenance and personnel costs, with some investment outlays specified for improving mainframe and personal computer hardware capabilities. At the same time, many are actively exploring the opportunities for new investment in software and communications development.

In fact, the balance of hardware and software spending within individual user sites can be expected to shift considerably over the next two years. Although affordable hardware will continue to draw considerable funding, most new investment will be slated for software development and the introduction and implementation of network communications. In particular, Eastern European IT sites will likely spend more on database technology, such as independent or portable database applications, and communications equipment for both local, enterprise-wide and wide area networks. There is also significant interest in procuring ready made, localised accounting applications for the region's new business environment, as well as integrated office solutions for client server configurations. Hardware spending will be largely confined to the low-end of the market, with most expenditures going to personal computers, small-scale open systems, Unix-based machines, local area networks and other client server technologies.

Nonetheless, it should be noted that many end-users are simply unable to conjecture what will happen within the next two years in the face of widespread economic uncertainty. Today, almost every company in Eastern Europe is confronted by an interrelated set of external and internal business problems, which undermine their ability to determine IT strategies and expenditures. The most often cited factors influencing the business operations of local companies include the following: economic and political instability; unstable legal and regulatory regimes; lack of investment capital; loss of major customers in the wake of the collapse of trade with the former Comecon countries, particularly with the former Soviet Union; uncertainty with company restructuring and privatisation; payments problems from local customers; outside competition from international firms; and serious stock control problems with the falling away of the sellers market. Some problems, of course, are unique to specific country markets. For example, the division of the former Czechoslovakian Republic is often cited by IS professionals as a significant detriment to that country's business environment. Many Polish end-users refer to their government's finance and taxation policies as a major factor hindering economic development.

In most instances, IS professionals in Eastern Europe have no control over the disbursement of IT expenditures, which must be budgeted and approved. A company director or board most often reaches the final decision to procure information technology, which is usually done though only after consultation with the respective IT department manager. It is also possible to find com-

panies in which consultants and organisations such as the World Bank play an important role in determining overall IT strategies and investment. The IT departments of various bodies of government administration must present annual IT expenditure plans which are subject to legislative approval.

Many DP managers also indicated that IT generally has one of the lowest priorities in their company's restructuring and privatisation process. This neglect stands in strong contrast to the important role that IT and MIS play in Western management and company organisation. In essence, there appears to be a general lack of understanding among many Eastern European managers of the role that IT can play in an enterprise: management, Western company organisation, and IT strategy must be learned from scratch.

3.3. Vertical Market Opportunities

Ongoing political and economic reforms are having an important impact on the transformation of most economic sectors in Eastern Europe. One important consequence is the extensive reorganisation of the entire public infrastructure and goods and service industries in the region. As staff reductions, privatisation, plant closures and insolvency become the order of the day for many enterprises, only a few vertical market sectors have retained the financial stature to revitalise IT infrastructures and consider the procurement of more advanced technology. Today, the most solvent vertical markets in Eastern Europe are represented by the following sectors:

1. Banking and Financial Services
2. Telecommunications
3. Government Administration
4. Industry & Manufacturing
5. General Services & Tourism
6. Companies with foreign capital, including joint ventures and subsidiaries, which usually adapt the computing concepts of their foreign partner.

In 1991–92, *banking and financial services* emerged as the most bouyant sector of the Eastern European IT market in terms of potential shipments. This development mirrored an urgent need to modernise the region's banking system and to create the essential financial infrastructure for the transition to a market-based economy. Bank restructuring and computerisation also reflect the necessity of securing the fluid transfer of profits and investment required to sustain growth in other sectors of the economy. This is now, and will continue to be, a prodigious undertaking, as the region's banking industry is extremely underdeveloped. In Poland, for example, just 30 bank branches serve Warsaw's 1.8 million people, while in comparison, 350 branches serve Vienna's 1.5 million people. Moreover, some bank branches in Warsaw handle 100,000 accounts, more than 20 times the number in many Western banks.

Substantial restructuring of the Eastern European banking system has led to problems which have illuminated the urgent need for information technology. Until 1988, most Eastern European banking systems consisted essentially of one large state bank, with other banks instituting policies set forth by it, and no adequate governmental supervison regulating the system. With the introduction of a free-market economy, this structure proved to be overly bureaucratic, with inadequate safeguards against the potential for embezzlement and fraud. Indeed, several Polish banking officials are now being prosecuted in connection with a check-kiting scandal.

Consequently, a number of new standards have been introduced throughout the region along with measures to restructure banking sys-

tems and services. New laws regulating deposits, transfers and check-writing have been passed in several countries. Furthermore, provisions have been made to allow the establishment of new privately-owned commercial banks in order to decentralise banking and financial services. Understandably, computer systems, which provide audit trails, track deposits and withdrawals, as well as supplying immediate account information, are essential to fulfill the new requirements.

The key to moving forward with computerisation in the banking industry has been locating the necessary funding. Here, the World Bank has played an instrumental role as a source of capital for the procurement of computers and related telecommunications equipment. For example, the World Bank granted Hungary a $ 66 million credit to upgrade the country's financial services sector and create an electronic banking infrastructure. Consequently, most international multiuser vendors active in this vertical market have chosen to concentrate their sales efforts on World Bank supported tenders.

As a result of limited funding, most Eastern European banking authorities have developed priorities of computerisation. Systems designed for inter-branch communication and check clearing are receiving the lion's share of funding. One reason for the emphasis on inter-branch communication is the necessity of sharing transaction information on a system which is independent of the country's obsolete telecommunications infrastructure. Other core banking activities, such as accounts information systems and foreign exchange transaction processing, are also receiving attention.

One of the most critical barriers to computerisation in Eastern Europe is the dire condition of the *telecommunications* network. Indeed, IT strategies across every sector are being stalled by the lack of a proper telecommunications infrastructure. Reports suggest that development of the Polish telecommunications system lags significantly behind those of less developed markets in Western Europe such as Greece. Each Eastern European government has recognised the importance of telecommunications modernisation, and has sought and received World Bank funds to finance it.

The possibility of computer system shipments in the wake of this investment is potentially high, particularly for firms which cooperate closely with the telecommunications divisions of their parent firms. Many are already attempting to provide systems integration, software development and program management for the cellular industry in Eastern Europe.

One factor encouraging the entry of many telecommunications firms in the region are extensive subsidies from their respective governments. Although eager for loans to improve their telecommunications infrastructure, Eastern European governments have realised that too many different types of hardware may lead to technical difficulties due to incompatibility. As a result, some countries are now attempting to limit the number of different systems employed in their networks.

Funding from private firms has also spurred the improvement of the telecommunications infrastructure. Both a Polish and a Hungarian banking consortium have funded their own national networks for data transmission. International computer vendors intend to build a communications network across Eastern Europe and sell usage of it. Already, one network has been installed in former Czechoslovakia, offering country-wide high-speed digital networking services for integrated voice/data information exchange.

Overall, 1991–92 has been a period of extensive reorganisation of local *government administration* in Eastern Europe, a process which will continue into 1993. Although the economic uncertainty surrounding administrative reform has discouraged the undertaking of large IT projects, state administration in Poland, for example, spent approximately $ 90 million on IT in 1991. Most hardware shipments consisted of personal computers or LAN installations in regional and central public administration, scientific centers and public educational institutions. Identifiable opportunities for shipments in the region still exist among governmental and state records agencies, such as social security, census statistics, and legislation.

Despite limited public funding for information technology, large systems integration projects are slowly becoming the order of the day. Indeed, the development of computerised information systems to handle areas such as tax collection, social security, and criminal records (both on the local and national level), as well as to monitor economic data in regional and national industries, are currently needed throughout the region.

In order to take advantage of coming tenders, vendors will have to work closely with central governments in assessing the breadth of the information technology challenges. One significant impediment to the realisation of local IT projects is the lack of nation-wide standards for data collection and processing. Consequently, refinements will have to be made in current IT procedures and regulations before IT strategies for processing such information can be implemented. Here, vendors could provide important consulting and developmental support.

One of the most important factors influencing the computer market at this level is the potential membership of Eastern European countries in the European Community. At a regional and national level, most public administration procedures are being altered to conform to EC standards. This, of course, includes the procurement of IT equipment. Most of these changes will have to be made within a certain timeframe, which places added pressure on the local governments to make IT improvements. One early implication of this agreement is the overhaul of nation-wide tax systems in the region, resulting in a totally new personal, income and value added tax structure. Major vendors providing assistance to local officials devising new IT strategies that conform to EC standards may receive special consideration when the contract is issued.

The government administration sector is also highly competitive where it is possible to encounter up to over 50 different companies bidding for one contract. Word of mouth and relations in government circles remain one of the most effective ways of finding out about potential tenders, which underscores the need to possess an active local sales force in the market, or at the least a few local employees with close connections to official decision-makers.

Aside from the international lending community and the EC, Eastern European governmental IT bodies will continue to play a key role in determining the parameters of IT development in the areas of banking, telecommunications and government administration. Although the dramatic changes in the region of the 1989–90 period brought an end to the dictatorial role played by state IT organisations in the development, application and distribution of IT, the newly formed democratic governments moved quickly to set up similar groups to influence IT development and to provide some level of standardisation for the computerisation of their economies.

In Poland, for example, the government has established a special steering committee on IT development to formulate national IT standards and to oversee the computerisation of public administration. Thus far, it is promoting OSI standards over other possibilities, in order to enhance interoperability across platforms. The organisation has specified OSI compatibility for all IT procurement in the public sector, having selected the Portable Operating System Interface for Computer Environments (POSIX) as a standard specification for portability and Informix SQL as the standard database engine. The committee along with the Polish Agency of Normalization and Measures have also begun work on the standardisation of PC keyboards, attempting to develop and introduce Polish characters in accordance with ISO guidelines and Latin-2 standards.

Hungary has probably gone the furthest among the Eastern European countries in preserving the government's role in influencing local IT development. Formerly, a number of bodies such as the Technical Development Commission, the Ministry of Industry, the Central Statistical Office, the Academy of Sciences, and the General Post Office were involved in promoting computing technology and local software development. Today, the government, with the support of the State Office for Technical Development (OMB), utilises a number of fiscal and monetary tools to support the development of a local IT industry. For example, it has introduced incentives such as tax rebates for local software developers, established so-called Technoparks, as well as promoted the development of "innovation banks" for local high technology industry. The Hungarian Minister of the Interior now bears sole responsibility for establishing IT standards and supervising the computerisation of public administration. Here, once again, an emphasis on open systems can be found.

In the former Czechoslovakia, a number of government and private organisations have emerged over the last two years to promote IT and specific technology standards. The federation established a committee in 1991 as part of the Czech National Council to oversee IT development in the country. There are also a number of IT organisations such as the Slovak Informatics Society, the SUVT, which tests IT equipment, and the Committee for Computer Users of the Chamber of Commerce, which provides information on tenders and government contracts, all of which are attempting to facilitate IT development and some type of standardisation.

Despite the widespread need for IT replacement and upgrading in the *manufacturing* sector, the shortage of investment capital and the ongoing recession in industry are limiting procurement to less expensive alternatives, such as small-scale systems, personal computers and LANs. With industrial production having fallen sharply in the region over the last three years, most enterprises in this vertical market have been undertaking little if any new investment in information technology.

One of the difficulties facing this sector is the widespread uncertainty associated with the privatisation process, which has undermined IT expenditures. Indeed, the confusion surrounding the privatisation of many state companies has limited the ability of many managers to implement new IT strategies. Nonetheless, there are subsectors of manufacturing and industry which have purchased computer systems over the last year. In particular, the energy and fuel industries were significant customers as a result of their slightly better economic and financial standing. Once again, most IT sales to industrial enterprises have been financed and supported with funding from the World Bank and the IMF.

Although *tourism and hotels* hold some potential for growth in the IT markets of Eastern Europe in the coming years, shipment activity is likely to be confined largely to personal computers and LANs. This sector also remains mostly state-owned, and like industry, it is currently undergoing organisational changes which may discourage capital investment and significant expenditures on information technology in the short term. This vertical market will begin to exhibit increased shipment potential in 1993, once the privatisation process of many hotels and tourism related services is complete.

Joint-ventures and Foreign Subsidiaries, although remarkable in numbers, have not impacted strongly on growth in overall IT expenditures. Hardware purchases have been limited primarily to brand-name personal computers and LANs. In the future, companies such as the large American retailer K-Mart buying a chain of stores in Czechoslovakia, or the purchase of automobile factories in Poland, Czechoslovakia and Hungary by major Western firms such as Mercedes and General Motors, may increase opportunities for international computer vendors, especially in the multiuser and CAD/CAM workstation markets. *New, private firms* have probably expended more capital on IT products than their foreign counterparts, but again mainly in the purchase of single-user systems and PC-related technologies. Indeed, private companies with less than five employees have accounted for significant numbers of PC sales in Eastern Europe.

3.4. IT Market Evolution

Figure 5 is an attempt to illustrate summary highlights of what have become common stages of development in the evolution of the information technology markets of the region in the wake of economic reform. The model graphically depicts an interrelated process of development through the year 2000, beginning with the initial demise of the centrally-planned economy and state-administered IT industry to the establishment of a free market economy and IT markets mirroring those of Western Europe. Changes are represented across five major areas integral to assessing IT market viability: IT Distribution, IT Market Structures, Economic Reform and Development, Multiuser Market Dynamics and Singleuser Market Dynamics.

The diagram begins with *Stage 1*, the state of the IT industry prior to the major changes which engulfed the region in the 1988–90 period. Here, the tenets of the Soviet model of a plan-administered economy required a closed market, void of outside competition, whereby the development, manufacture and distribution of information technology were monopolised by the state. A few carefully controlled joint-ventures and cooperatives were permitted, although entrepreneuralism was restrained by a restrictive legal and fiscal regime. At this stage, IT development and production of the indigenous industry can be regarded as virtually obsolete at almost all levels in comparison with Western counterparts, e. g. personal computers, multiuser systems, communications etc.

The early transition to market-based economies in *Stage 2* reflect the initial shock of the virtual disintegration of the region's centrally planned economies. State distribution channels begin to collapse, the economy falters, and state-controlled computer production is terminated. In the ensuing confusion, the few IT competitors scramble to gain a foothold. Foreign trade organisations (FTOs), joint-ventures and international IT vendors become active in the IT market and seek out financially solvent customers. Entrepreneurs take over defunct manufacturing facilities and begin to assemble PCs with components sourced from the Far East.

Figure 5
IT Market Evolution in Eastern Europe, 1988-2000

Stages	1	2	3	4	5	6
Stages IT Distribution	Monopolised state-controlled IT distribution	IT distribution channel disintegration: state channels collapse	IT channel chaos: sourcing both legal and illegal channels, no-name "dealers" proliferate	IT distribution channel evolution: Western distribution strategies are increasingly adapted	IT channel consolidation: dealers, VARs and chain retailers emerge with local subsidiary support	IT distribution mirrors that of Western Europe
IT Market Structure	State enterprises, cooperation and a few joint-ventures	State enterprises, cooperatives, joint-ventures, FTOs, international IT vendors	Joint-ventures, FTOs, private cooperatives, international subsidiaries, private firms	Private local firms, FTOs, chain retailers, subsidiaries of international IT vendors (retailers & wholesalers)	Private local firms, chain retailers, subsidiaries of international IT vendors	
Economic Reform & Development	Soviet Model of centrally-planned economic development	Economic stagnation, measures for economic stabilisation	Price liberalisation, devaluations, create initial economic instability	Customs reform, financial and tax reform, process of privatisation commences	Currency convertibility, private sector begins to fuel economic recovery	Full market-based economic system develops
Market Dynamics (Multiuser)	CMEA vendors dominate in a closed market with obsolete technology	CMEA multiuser industry collapses due to outside competition and cuts in state subsidies	Multiuser market stagnates as international vendors develop operations	Remnants of CMEA multiuser industry provide peripherals and application development support	International multiuser vendors garner 100 percent of market share	Unix, downsizing, used systems and low-end mainframe shipments are standard market features
Market Dynamics (Single-user)	Limited PC assembly by state enterprises and cooperatives utilising local and imported components	State firms terminate production, first local assemblers appear	No-name PCs dominate the market, sourced from Far East. Local assemblers proliferate	Market consolidation due to price war: large local PC assemblers and component suppliers thrive	Dissatisfaction with operation of cheap clones makes brand-names more popular	Brand-name vendors and large local assemblers and components distributors control market

In these initial stages, distribution and IT market structures throughout the region are somewhat primitive by international standards. Established trading companies become the first so-called "dealers" in the market, as they are the only organisations with access to hard currency and which are familiar with and capable of negotiating through complex import/export regulations. Both brand-name and no-name PCs are sold through these channels, mostly in the context of barter trade, as the chaotic economy forces currency fluctuations which result in unmanageable instability in financial undertakings. PCs are also sourced from neighboring countries to be sold through illegal, black-market channels. As a result of a combination of pent-up demand and the inability of average end-users to acquire hard currency to perform their own clandestine trade, some blackmarket dealers can earn as much as 200 percent margins on sales.

The first changes made once a new government is firmly in place are those necessary to control, and at the same time, further legitimise the move to a market economy. In *Stage 3*, price liberalisation releases controls on most goods, while devaluation prevents the accumulated overhang of local savings from threatening the financial stability of the country. Currency reform also brings local currencies closer to their real values, representing the first step towards currency convertibility. Rising prices and devaluation, in combination with a sharp decline in overall industrial production, also contribute to high inflation.

While the multiuser sector lulls in the midst of insolvency and production difficulties on the part of local producers and lack of financially stable customers for international vendors, activity in the PC market escalates. Local assembly operations begin organising component sourcing, dealer networks and advertising for their products. Initial customers are mostly government agencies, agricultural cooperatives and state enterprises because of the limited funding available to private individuals for expenditures on information technology.

Despite radical changes, some international vendors and local entrepreneurs concentrate their efforts on establishing a proper IT market infrastructure. Rudimentary distribution and dealer networks are formed out of trading companies and the IT departments and research institutes of local universities. Western marketing strategies, such as franchising, are copied and implemented with varying degrees of success.

By *Stage 4*, initial optimism over market demand fuels competition between PC assembly operations, while international vendors attempt to resuscitate what is left of the local multiuser industry to build upon it. Local PC assemblers enter into a vicious price war, as skillful component dealers purchase stock in volume and continually undercut market prices. The attrition resulting from the heavy competition leaves a few large, highly successful assemblers in control. In the multiuser industry, the remnants of former manufacturing facility, i. e., service support organisations, peripheral production and software development teams, are acquired by international vendors to serve as local points of distribution and software application support.

An increasingly successful private sector, aided by a fully convertible currency, begins to generate economic momentum by *Stage 5*. This allows the market to begin to assimilate a market structure similar to that in the West. In distribution, for example, successful surviving PC assemblers are contracted to become VARs for brand-name PC vendors. This enables them to enter vertical markets and increase their margins, which were decimated during the previous price-war. Western chain distributors begin organising distribution networks.

International vendors in both the multiuser and PC markets begin to gain ground in this economic climate. Multiuser vendors have by this time gained dominion over the local market. International PC vendors are shipping slightly more expensive machines due to a legacy of poor performance by cheap clones. Such vendors are supplying service and support, as well as hardware guarantees, which earn the recognition of dissatisfied clone users.

Finally, a complete market-based system emerges by *Stage 6*. Brand-name vendors, and large local assemblers and component distributors control the PC market. Standard features of the multiuser market include substantial sales of low-end mainframes, second-hand machines, small-scale systems, Unix and client server configurations. Downsizing emerges as one of the most important trends, as mainframe systems manufactured by the former CMEA are frequently replaced with powerful small-scale systems and local area networks (LANs). Distribution and IT market structures mirror those found in the West.

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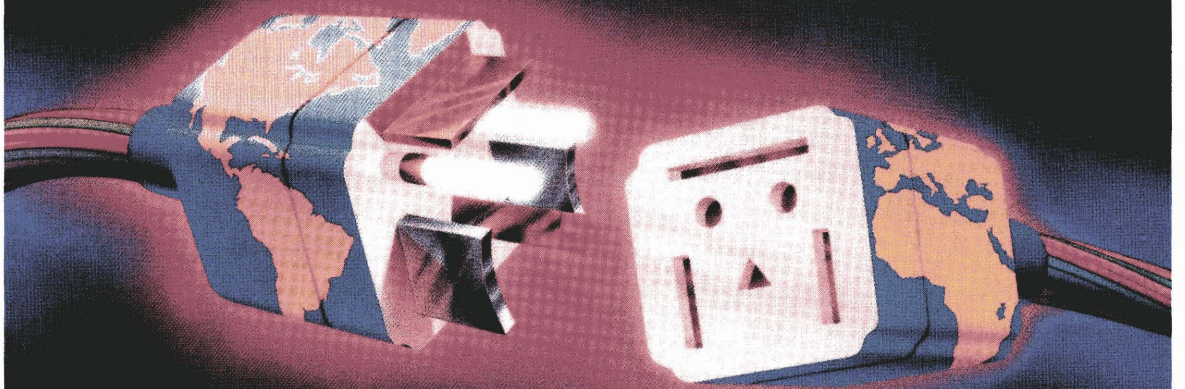

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Environmental Achievement in Information Technology

1. The Role of Ecological Challenges for the European IT Industry

Many events highlight the fact that the harmonisation of economy and ecology is one of the most important challenges for humanity. The discussions at national and international level are dominated by the paradigm of "sustainable development".

This paradigm was the key idea of the Rio-UNCED-Conference, which declares the main responsibility of the industrialised countries for measures for a global sustainable development: "Achieving the goals of environmental quality and sustainable development will require efficiency in production and changes in consumption patterns in order to emphasise optimisation of resource use and minimisation of waste. In many instances, this will require reorientation of existing production and consumption patterns that have developed in industrial societies and are in turn emulated in much of the world."

The requirements of these fundamental changes lead to the growing consensus in the business world and among IT companies "that tomorrow's winners will be those who make the most and the fastest progress in improving their eco-efficiency, because

- customers are demanding cleaner products;
- banks are more willing to lend to companies who prevent pollution rather than pay for clean-up;
- insurance companies are more amenable to covering clean companies;
- employees prefer to work for environmentally responsible corporations;
- environmental regulations are getting tougher;
- new economic instruments - taxes, charges and tradeable permits are rewarding clean companies."*

The realisation of eco-efficiency requires an integrated approach to environmental protection including the definition of goals, the decision about products, the choice of production methods, the use of materials, the personnel policy as to the design of working conditions and the ecological impact of transport systems.

The IT Industry is meeting these new challenges and has already taken important initiatives in this direction. The ecological challenges represent a great opportunity and the IT Industry will play an important role in this decisive task for the preservation of living conditions on earth.

The IT Industry is strategically in a good position in future ecological development *(Figure 1)*. IT creates an environmentally friendly improvement of products and processes and makes substitution of products and processes possible, e.g. through environmental information systems or communication types of "telepresence" or "telecooperation". This results from the fact that the object of the IT Industry is information, an immaterial good, for whose distribution/processing only relatively few resources are required.

* Quotation from Mr. Schmidheiny, BCSD

This positioning provides ideal conditions and opportunities to play an active role in coping with challenges of environmental policies.

The ecological engagement of the IT industry concerns three fields of activities:

1. Environmental management within the company
2. Ecological product design
3. Environment as a growing IT market.

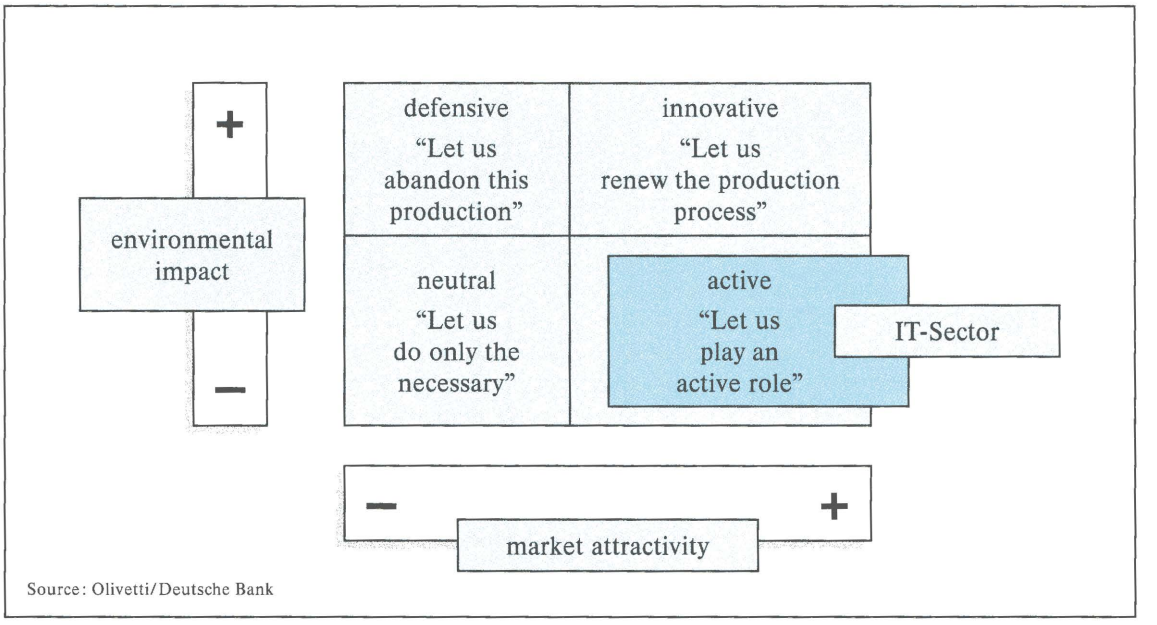


Figure 1: Strategic Positioning of IT-Sector in Future Ecological Development

1.1. Environmental Management within the Company

As any other company, IT companies are integrated in a complex system of environmentally relevant relations *(Figure 2)*.

In order to take into account these environmentally relevant relations it is necessary to implement integrated procedures for environmental protection within the company. Already today there are successful companies which practice, for instance, environmental auditing or efficient energy management. Accordingly, IT companies have established integrated environmental protection in their company rules.

Waste Reduction and Waste Management

IT manufacturing processes generate wastes or chemical emissions in solid, liquid and gaseous forms. All manufacturing operations are required to develop source reduction and pollution prevention plans. These plans, which identify priority hazardous wastes and chemical emissions and set targets for reductions, are based on the pollution-prevention hierarchy of "reduce, reuse, recycle, treat, dispose".

In particular this policy targets hazardous waste source reduction, elimination of ozone-depleting chemicals and solid waste reduction and recycling.

An example of the reduction and avoidance of emissions is the reduction, and even since the early nineties the complete substitution, of CFC in the production of printed circuit boards or microchips of leading IT manufacturers in Europe. With high investment this has already been achieved several years before the corresponding legislation comes into force.

The IT Industry aims at the realisation of the most environmentally friendly combination of recycling, treatment, landfill and incineration for the management of hazardous waste.

Pollution Control

IT manufacturing and its support operations acquire, store, process and otherwise handle chemicals and their associated waste products. For many years IT companies have maintained programs of risk assessment, procedural and physical controls and monitoring to prevent the accidental release of these chemicals and wastes to the environment. This is being achieved by waste water monitoring, chemical storage and handling and remediation of soil and groundwater. There already exist successful projects with a growing share of material flows included in circulation processes.

Resource Conservation

Natural resource conservation is now becoming a much larger local, regional and global concern. For instance, in the key area of energy conservation many IT companies have implemented energy-management upgrade programs,

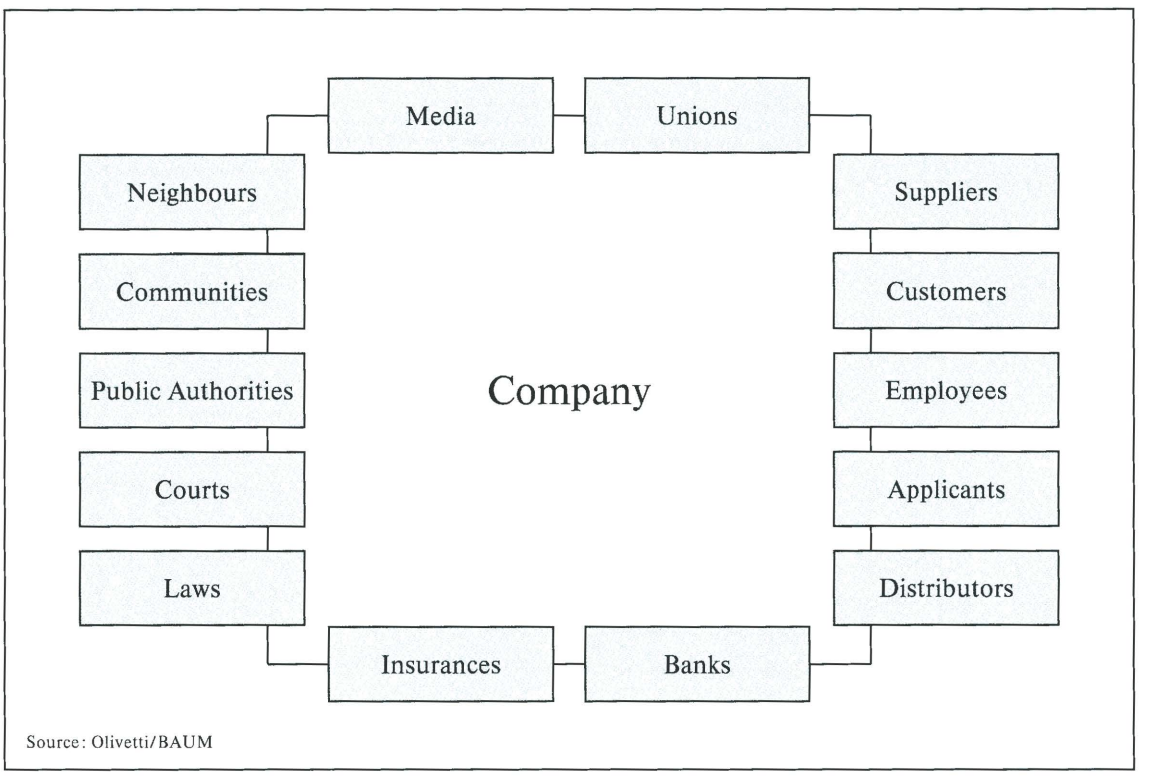


Figure 2: Environment and the Company: The Company's Environment is Environment Sensitive

including lighting systems. Savings in energy use for lighting-upgrade projects alone range from 20 to 50%.

Local governments often establish energy-conservation goals and requirements for new or remodeled buildings. Many IT companies incorporate all applicable rules and requirements into their new building designs.

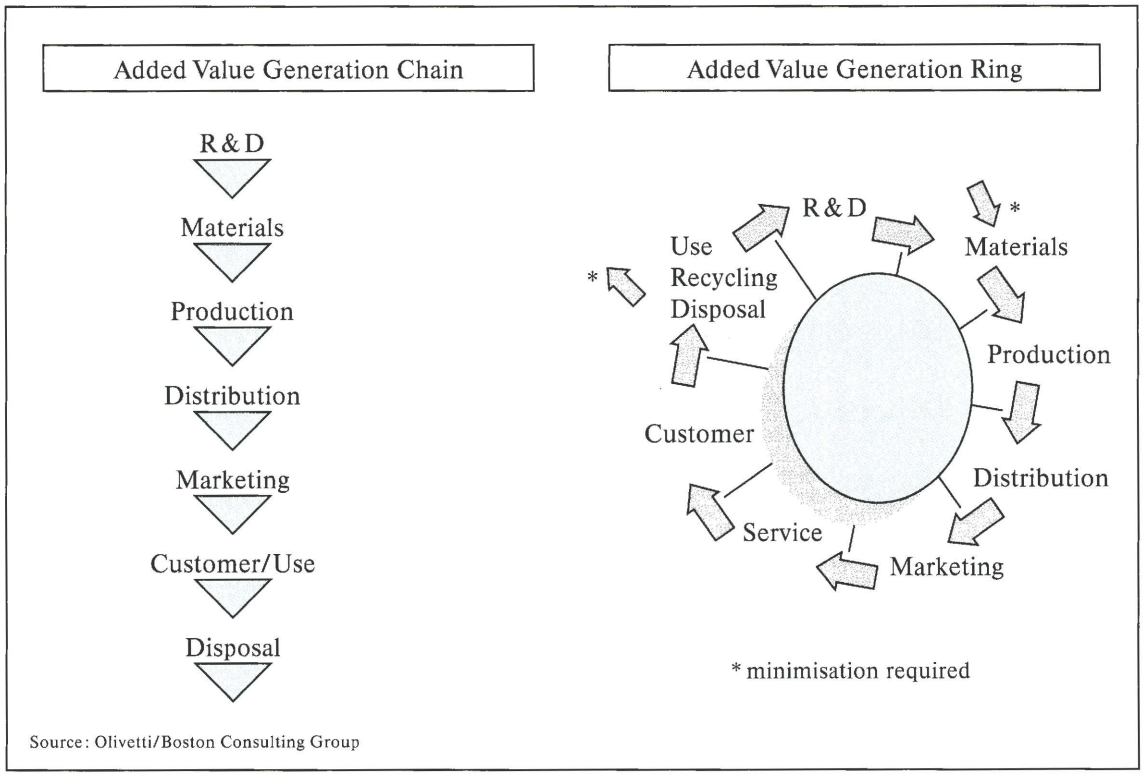
Prior to manufacturing processes and associated equipment being updated or replaced, environmental reviews are performed in the process design and equipment acquisition phases. Energy use and opportunities for conservation are considered as part of these reviews.

1.2. Ecological Product Design

The conventional requirements for good equipment design have been manufacturability, performance, cost, safety during use, ease of servicing and aesthetics. Increasingly, environmental aspects are being incorporated into design criteria.

In order to minimise the consumption of resources and waste it is necessary to overcome the present linear sequence of production, consumption and waste management (added value generation chain) in favour of a circular production and economy (added value generation ring) *(Figure 3)*.

Figure 3: The "Ecological" Product – From the Added Value Chain to the Added Value Ring



IT manufacturers are working hard to implement a progressive ecological product policy by:

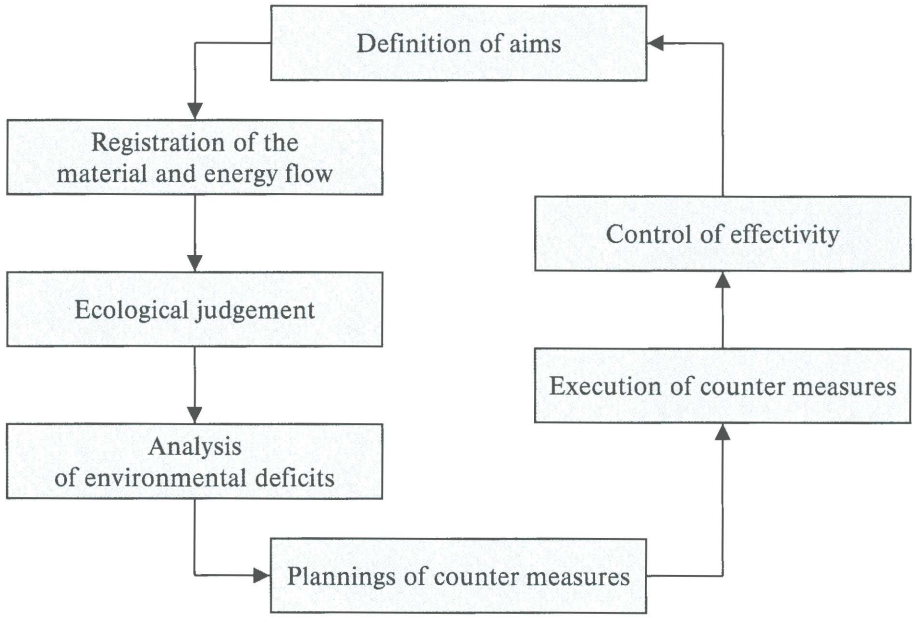
- inclusion of recyclability in design guidelines,
- easy disassembly of IT appliances,
- minimisation of the variety of materials (plastics),
- marking of material,
- avoidance of materials unsuitable for recycling or harmful,
- extending of the duration of life cycle,
- repairfriendly construction,
- multiple utilisation of parts.

1.3. Environment as a Growing IT Market

Since environmental applications of IT are an essential condition for the ecological modernisation of the economy and beyond this for the entire society, environment is one of the important future markets for IT industry.

In 1990, for instance, the German market for environmental protection altogether amounted to about DM 52 billions and is likely to grow to DM 100 billions in 2000.

The share of IT in this market is estimated to reach DM 4 billions in the period from 1991 to 1994. In 1995 the volume is expected to reach DM 1.5 billion and about DM 7.5 billions by the year 2000.



Source: PSI Gesellschaft für Prozeßsteuerungs- und Informationssysteme

Figure 4: Environmental-Controlling (Implementation of ECO-Controlling)

Nowadays the implementation of effective environmental policies absolutely requires the use of electronic data processing systems. Data have to be collected, evaluated and saved in order to obtain a solid basis for decision.

1.3.1. Environmental Applications of IT

IT manufacturers offer appropriate hardware, software and consulting, engineering and complete project management in the following areas:

a) Corporate Applications of Environmental Information Systems

Environmental information systems or management systems are preconditions for the establishment of an integrated environmental protection within the company. In this field the first stages and procedures of Eco-controlling in the sense of an ecological accounting are being applied *(Figure 4)*.

Besides setting the ecological objectives of the business and analysing weaknesses, the ecological controlling system includes planning and implementing the measures to be taken, monitoring improvements by periodically carrying out the analysis of weaknesses and the use of data-processing systems as an essential instrument of assistance. In this way ecological objectives are integrated into products and process systems and ecological information is collected, classified, prepared and submitted to the management.

Ecological controlling is based on three core elements: material and energy balances, product life-cycle analysis and regular up-dating of changes in the production process, product design or product composition, as well as framework conditions (legislation, regulations).

Other areas of corporate applications are ecological cartography, information and communication systems about hazardous and environmentally relevant materials or expert systems for hazardous waste transports. These IT applications are intended to support authorities, carriers and chemical companies as well as companies dealing with waste management concerning danger avoidance.

The main sectors of environmental information systems concern waste, water, soil, air and applications for environmental impact assessments. Standard applications are data banks (e. g. information on literature, legislation, hazardous materials, specific branch problems) and expert systems (e. g. environmental impact assessments).

b) Territorial Applications of Environmental Information Systems

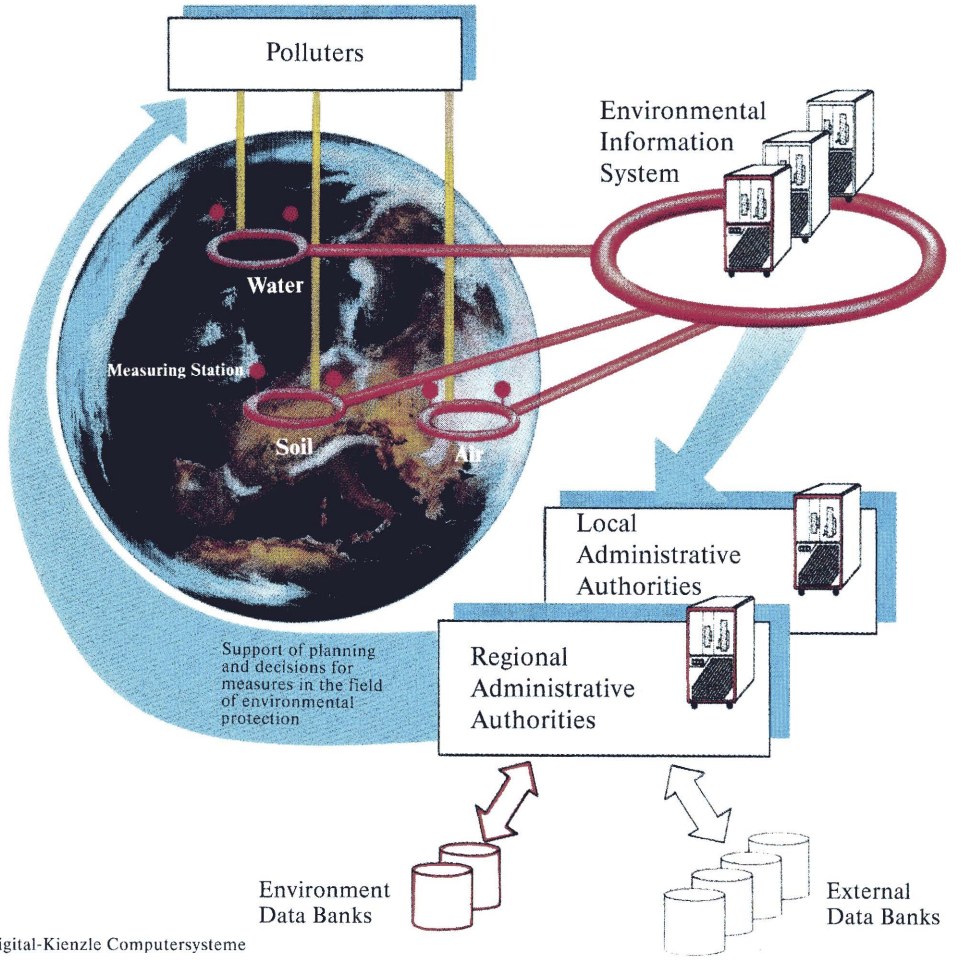
Environmental information systems at regional and local level *(Figure 5)* integrate sensors, components of remote data transmission, data collection and data evaluation, and are based on IT systems and networks.

Public authorities, for example, have implemented environmental information systems with the following tasks:

- information support for policy, administration and the public;
- investigation and analysis of selective and regional ecological situations;
- support for emergency and risk management;
- coordination and integration of existing procedures of environmental information.

c) Global-oriented Environmental Information Systems

The analysis of global ecological problems is only possible with appropriate support of IT systems. In research on climate change, for instance, forecasting global climate change and its effects is not possible without extremely complex simulation models processed by high performance computing.



Source: Digital-Kienzle Computersysteme

Figure 5: Territorial Application of an Environmental Information System

1.3.2. Environmentally-friendly Effects of IT Applications

Transport services can be improved by IT and can moreover be substituted by telepresence and telecooperation. Possible areas are e. g. the telecommunication infrastructure and electronic data transmission networks, as being of critical importance for quality and quantity of transeuropean networks and services. Beyond the initiatives of the IT Industry in Europe, the EC Commission launched R&D-projects to foster the basic preconditions for future communication infrastructures (e. g. European Nervous System (ENS) or Transeuropean Networks (TEN) in the Framework Program of Community Research and Technology Development).

2. The European Community

General framework conditions and developments of European environmental policy have marked effects on the production and the whole value added chain of the IT Industry. For this reason this section gives a short overview of important environmental activities of the EC and the European IT industry.

2.1. EC Environmental Policy and Environmental Standardisation

Environmental policy was not part of the European Community's policy until 1972. It was not provided for in the original Treaties. Over the past two decades four Community action programs on the environment - the fourth runs up to the end of 1992 - have given rise to about 200 pieces of legislation covering pollution of air, water and soil, waste management, safeguards in relation to chemicals and biotechnology, product standards, environmental impact assessments and protection of nature. *

Under the amendments of 1987 to the Treaty of Rome, which serves as the EC Constitution, the EC's members agreed to abide by the decisions of a qualified majority rather than an unanimous vote on many environmental issues. The rule of qualified majorities is supposed to be extended to most environmental issues in the near future.

Another important institutional change is included in the amendments of 1987 referred to as Title VII. Its farthest-reaching impact will probably come from its declaration that the environment will become a component of all the EC's other policies - including those covering regional development, agriculture, trade, research and industrial development. In addition, Title VII contains three principles that are aimed at making polluters pay for clean-up, prevent and control emissions at their sources rather than at the "end of the pipe", and take preventive action to ensure public safety and environmental protection. The Maastricht Treaty confirmed again the European environmental policy.

The EC Commission issued a communication (prepared by DG III and DG XI) on "Industrial Competitiveness and the Protection of the Environment". **

According to this position the tasks of the Community in this field will be based on three dimensions:

- a qualitative improvement in the degree of integration of environment and industrial policies in order to derive positive benefits for both policies;
- a constructive dialogue with industry to improve the effectiveness of environmental policy;
- the maintenance of the integrity of the Internal Market.

The position outlines recommendations and requirements of the EC in the field of industrial competitiveness and the environment, inter alia, concerning environmental policy, internal market, trade policy and technology policy.

A major new mark of the Community's commitment on the environment was registered with the decision to set up a European Environment Agency. Its task will be to provide objective and comparable data on the state of the environment in Member States, thereby providing a sound scientific basis for newly drafted Commission directives and enhanced authority for those trying to enforce existing ones.

Fifth EC Environment Action Program

The Commission prepared the fifth EC environment action program (EAP), which came into force at the beginning of 1993 and covers the period up to the year 2000, with some indications of likely developments up till 2010 and beyond

* The EC (DG XI) published an overview: "European Commission Environment Legislation" (7 volumes EC 1992)

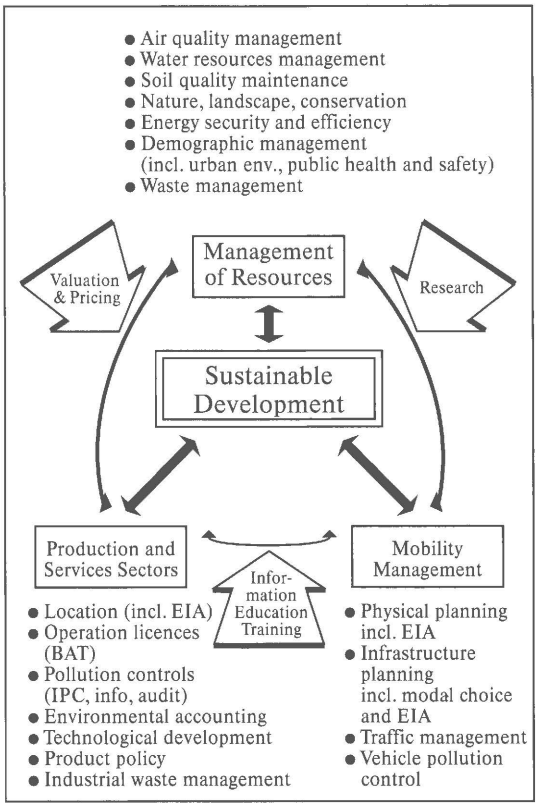
** Adopted by the Commission on November 4, 1992 (COM [92] 1986 final) and presented to the EC Council

(Figure 6 and *Figure 7).* The programme "Towards Sustainability - A European Community Programme of Policy and Action in relation to the Environment and Sustainable Development" (EC Communication COM [92] 23 final, March 27, 1992) is expected to adopt a flexible approach to policy options in line with a long term strategy, but also provides short (1995) medium (2000) and long term (2010 and beyond) objectives, thus allowing adaptation of the program every two years according to the results obtained. It will therefore do more than just set out a list of legislative measures to be taken in given fields, as has been the custom since 1973 when these programs were first launched.

The program emphasises in particular the need to consult industry and others. Furthermore an advisory committee will be set up consisting of representatives from industry, local authorities, non-governmental organisations and the Commission.

Environmentally-oriented Activities for Standardisation

The ISO Council established the "Strategic Advisory Group on Environment" (SAGE) on August 16, 1992. The European Committee for Standardisation (CEN) published a position paper "Environmental Standardisation by CEN - A Proposal for a General Outline of Activities" (BT Working Group 64 "Environment", September 1992): "Environmental standardisation covers a great number of subjects. It includes the development of standardised measurement procedures, standardised performance characteristics for pollution control equipment and standardised environmental management tools (comparable with the ISO 9000 series on quality control). This excludes legal aspects like the setting of (legal) limit values and the establishment of criteria for evaluation of compliance with these limit values, but includes the standardisation of methods for this evaluation. The setting of limit values and the kind of procedures for testing compliance with those values is a task of the legal authorities."



Source: EC-Commission

Figure 6: 5. EC Environment Action Program: Sustainable Development

2.2 Environmental Activities of the EC and the IT Industry

Many EC environmental regulations are not IT specific but have to be adapted to IT production and products. Beyond this, there are EC planning activities, particularly for requirements on accepting back, recycling and disposal of used electrical and electronic appliances. Some of the existing and planned environmental regulations of the EC and initiatives of the industry are requiring and fostering new IT applications

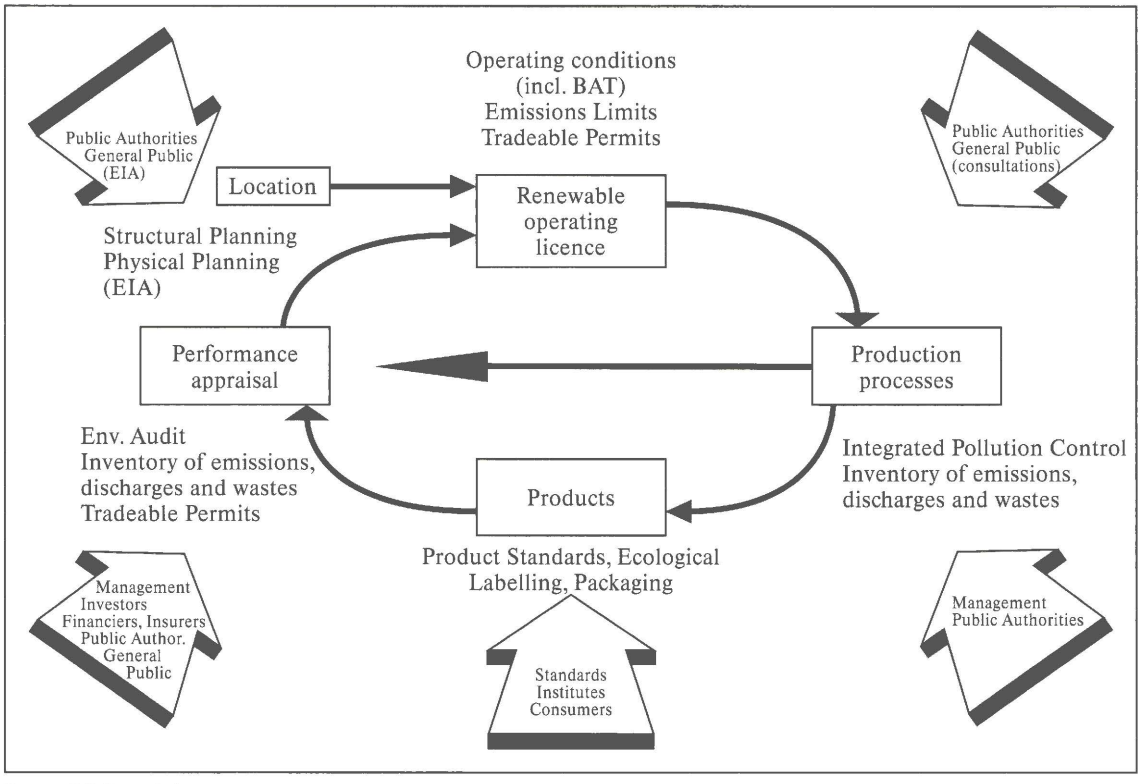


Figure 7:
5. EC Environment Action Program: Regulatory Process to Promote Environmentally-friendly and Competitive Industry

Source: EC-Commission

and therefore these developments represent simultaneously challenges and opportunities for the IT Industry.

The state of progress of important EC environmental regulation projects regarding instruments of environmental policy, waste legislation and volatile organic compounds (VOC) legislation is shown in *Table 1.*

2.2.1. Environmental Management

IT companies in Europe had already given environmental protection a permanent place in their management structure. An important element of environmental management in companies is a transparent information policy. Many companies regularly inform the public about their environmental activities.

A solid information base is also the best starting point for the environmental management of a company. This is part of the increasing number of IT environmental applications. A comprehensive aid used by company management to systematically record company environmental data is the so-called environmental audit that is being used in many companies. The International Chamber of Commerce (ICC) has devised a form to be used for the environmental audit *(Figure 8).* The audit ensures that clear information about the extent and value of environmentally-related operations within the company and its individual departments is obtained at all times, just as in company cost accounting. Following this

Table 1: EC Environmental Regulations: State of Progress (October 9, 1992)

Topic	Legal basis: articles of the Treaty (1)	Commission (Publication in Official Journal [C])	Adoption by Council (Publication in Official Journal [L])
Selected EC Instruments of Environment Policy			
Eco-label	130 s	20. 03. 1991	11. 04. 1992
Eco-audit	130 s	27. 03. 1992	x
Eco-taxes - CO_2	99 & 130 s	COM (92) 226 fin	x
Environment statistics	130 s	22. 08. 1990	x
Selected EC Waste Legislation			
Waste	130 s (2)		26. 03. 1991
Hazardous waste	130 s (2)		31. 12. 1991
Transborder shipment of waste - Regulation - Basle Convention	 100 a 113	 17. 11. 1990 COM (90) 362 fin	 x
Civil liability	100 a	04. 10. 1989 modified 23. 07. 1991	
Landfill of waste	100 a	22. 07. 1991	
Incineration of hazardous waste	100 a	21. 05. 1992	
Packaging	100 a	12. 10. 1992	
Disposal of PCB/PCT	100 a	12. 12. 1988 modified 20. 11. 1991	
Selected EC Legislation on Volatile Organic Compounds (VOC)			
Regulation on substances that deplete the ozone layer (modification)	130 s	COM (92) 106 fin	to be finalised by Council on 20. 10. 1992
Montreal Protocol: - London Amendment	 100 a		 31. 12. 1991
Protocols to 1979 Geneva Convention - "NO_x" Protocol - "VOC" Protocol	 130 r	 04. 09. 1991 modified 15. 09. 1992 COM (91) 394 fin	 x
Ozone control in the atmosphere	130 s		13. 10. 1992

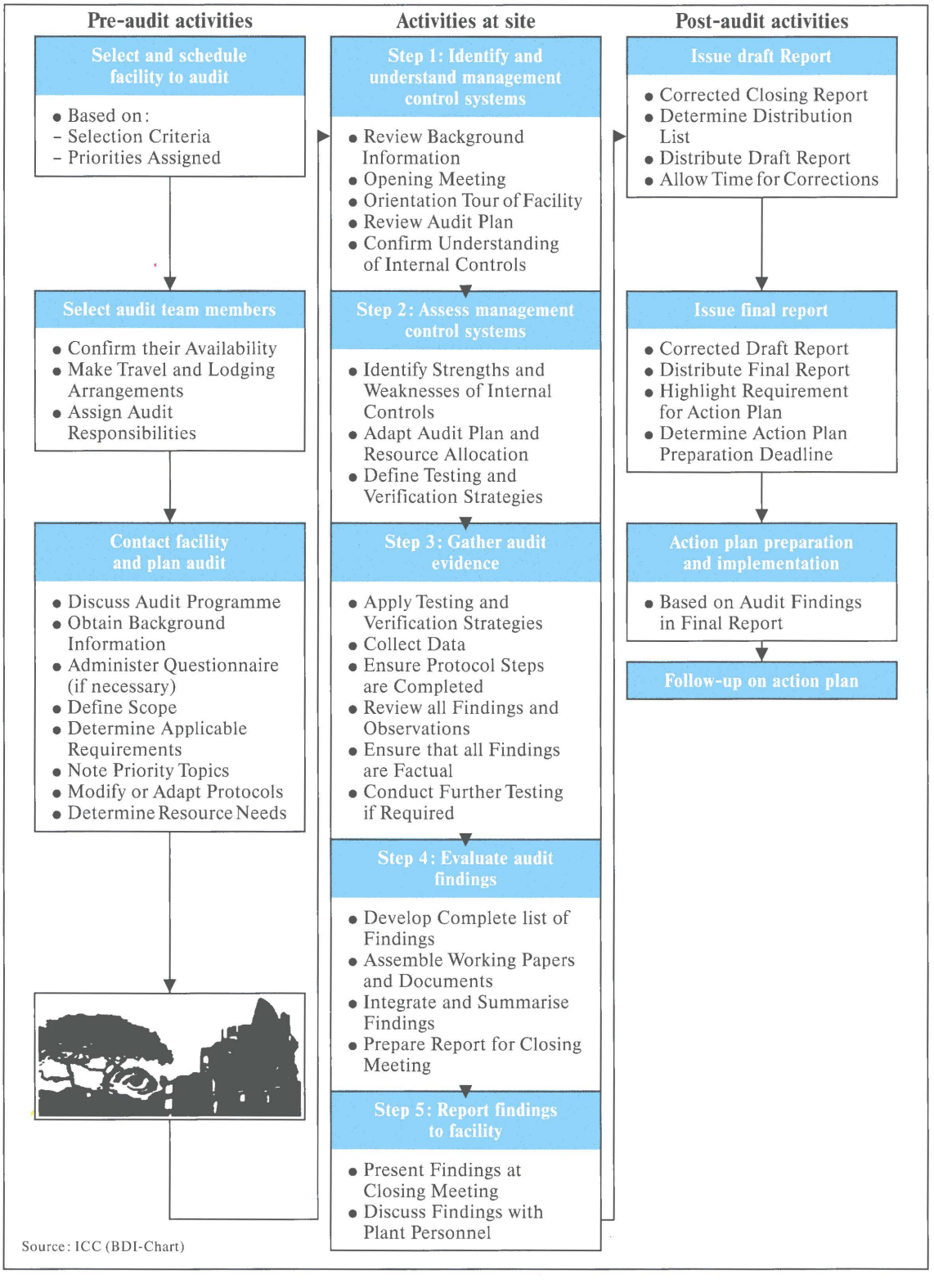
x The discussion is taking place

(1) Articles of the Treaty; Internal Market (Art. 99, Art. 100 a); Trade Policy (Art. 113); Environment Policy (Art. 130 r, s)

(2) The Commission has filed a complaint against the Council in order to repeal the Directives (judgement in 1992?)

Source: ORGALIME

Figure 8:
Basic Steps of an Environmental Audit



Source: ICC (BDI-Chart)

ICC-scheme the EC Commission presented a "Proposal for a Council Regulation allowing voluntary participation by companies in the industrial sector in a Community Eco-audit scheme" (COM (91) 459 final, published in the Official Journal (C) on March 27, 1992).

Both schemes for Eco-audits are complemented by the British Standard "Specification for Environmental Management Systems" (BS 7750, BSI 1992): "On their own, however, reviews and audits cannot provide an organisation with the assurance that its performance not only meets, but will continue to meet legislative and policy requirements. To be effective, they need to be conducted within a structured management system, integrated with overall management activity and addressing all aspects of desired environmental performance".

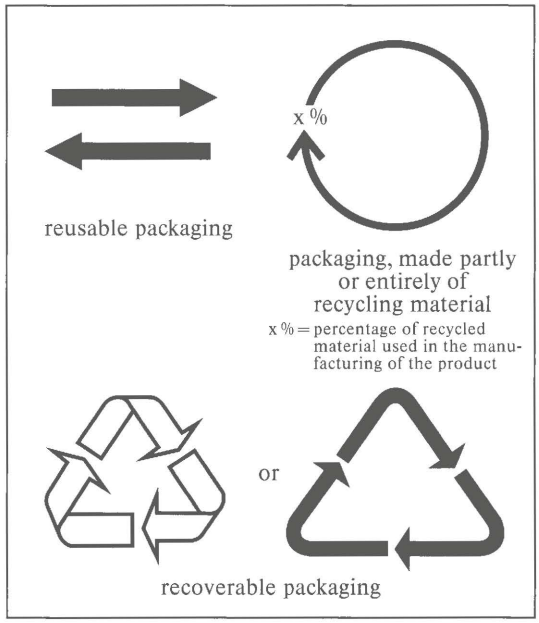
Objectives of company environmental management are defined in the ICC charter for "Sustainable development" which has already been signed by several IT companies. The charter contains 16 principles which bind companies to a transparent information policy, rational and economical use of all natural resources and ecologically acceptable products and production structures.

2.2.2. Waste Management: Selected Measures at EC Level

a) Packaging and Packaging Waste

The EC Commission presented a Proposal for a Council Directive on packaging and packaging waste (COM (92) 278 - SYN 436) published on October 12, 1992.*

The proposed directive classifies three types of packaging as in the German packaging directive: "sales packaging", "grouping packaging" (or "bundle packaging") and "transport packaging".



Source: EC Official Journal c 263/8, October 12, 1992

Figure 9: Marking of Packaging According to the Proposal of the EC Packaging Regulation

The Commission has put forward provisions requiring a general 90% recovery target covering all packaging materials and within this a 60% recycling target for each type of packaging, either paper, plastic, wood or metal. The directive would give the Member States 10 years after the directive enters into force to take measures to attain these targets.

The Member States shall ensure no later than 5 years after the directive enters into force the setting up of systems to return all used packaging and/or packaging wastes from the consumer/enduser, to channel it to the most appropriate management alternatives, and to reuse or recover it effectively.

With the same timescale of 5 years all packaging has to be marked - logos are shown in *Figure 9*.

Appropriate measures shall ensure that packaging may be placed on the market only if it meets some essential requirements, e. g. its re-

* This proposal is based on Art. 100 a (Internal Market) and not on Art. 130 r, s (Environmental Policy) of the Treaty with the consequence that national regulations would have to be on the same level in every EC country. In the current progress of legal approval, some countries (Denmark, Germany, Luxemburg and the Netherlands) have objected to this. Therefore, the legal basis of the proposal will perhaps be changed from Art. 100 a to Art 130 r, s.

coverable nature. Particularly it shall be ensured that packaging waste processed for the purpose of energy recovery shall have a minimum inferior calorific value of 13 MJ/kg (the approximate energetic value of paper and board).

b) Waste from Used Electrical and Electronic Appliances

The Commission agreed to classify electrical and electronic waste as a priority waste stream within the "Management of priority waste streams scheme". After used tyres and chlorinated solvents, electrical and electronic waste is a further priority waste stream project of the EC.

For each waste stream the scheme requires a working group consisting of national and EC officials and representatives of industry, consumers and environmental protection groups. The Italian Environment Ministry agreed to take on the coordination of this task for 1993.

2.2.3. Environmental Labelling

The growing environmental consciousness among the population is evidently influencing markets. Because of the increasing interest of users in information about products with low environmental impact, some Member States introduced award schemes for Eco-labels.

Also the EC launched an Eco-label award scheme ("Council Regulation No. 880/92 on a Community Eco-label award scheme" on April 11, 1992). The aim of this regulation is to create the conditions for ultimately establishing an effective homogeneous award scheme for environmental labels in the Community.

It is expected Eco-labels are also to be awarded for IT products.

The Eco-label award scheme is supposed to promote the design, production, marketing and use of products with low environmental impact during their entire life cycle. The Commission shall consult the principal interest groups with a view to the definition of the product groups and the specific ecological criteria.*

2.2.4. Product-specific Activities of the IT Industry

The Working Group European Printer Manufacturers and Importers (EPMI) deal, inter alia, with environmental issues of design and use of printers. EPMI has published a first edition of requirements for the marking of plastic parts of printers and exercises general support to its member companies in safety, health and environment aspects of printers.

A summarised EPMI brochure on these subjects was published in 1991 analogous to a similiar brochure for copiers of the German Manufacturers and Importers of Office Communication Systems (AG KHI) within the VDMA.

3. National Product Activities by the State and the IT Industry

Beside the growing number and areas of European-wide regulations for environmental matters, there exist many different national provisions and agreements on specific environmental subjects. These agreements require specific national adaptations for the development and production of IT products and create new areas for the application of Information Technology.

3.1. Packaging

Many public and private initiatives on the avoidance of packaging waste exist or are planned in Europe. One basic common principle is that companies of the commercial, industrial and the packaging sectors join a system which guarantees a regular collection of packaging waste close to the enduser.

* The representatives of four interest groups are to be designated by their organisations:
- Industry: UNICE
- Commerce: CECD, FEWITA, GEDIS
- Consumers: Consumer Consultative Committee
- Environmental organisations: European Environment Bureau EEB

Table 2: Survey on Regulations on Packaging in Different European Countries

Country	Legal Basis	Year	Scope
Austria	Packaging waste ordinance	1/1993	all packaging
Belgium	voluntary agreements	1991	household and packaging
Brussels and Walloon	draft law		packaging waste
Flanders	packaging covenant	1991	all packaging waste
Denmark	legal framework in place		all reusable packaging
France	Decree concerning the elimination of waste and the recovery of material	4/1992	all packaging
Germany	Packaging waste ordinance	6/1991	all packaging
Netherlands	packaging covenant	6/1991	all packaging
Norway	draft for general law on waste reduction and minimisation incl. packaging waste		all packaging
Sweden	proposal for a law on collection and recycling of packaging waste (along the lines of the EC proposal)		all packaging
Spain	Implementation of EC-Directive 339/85 on liquid food containers and development along the lines of the EC proposal		all packaging
Turkey	solid waste control regulation	3/1991	plastic and metal packaging
United Kingdom	Government adopted a White Paper on the environment	1990	
	Integrated Solid Waste Management Business Plan	3/1992	all solid household waste (i. e. not just packaging)

Source: European Association of Industries of Brand Products A. I. M.

There are clear differences concerning what is meant by reusable packaging and the energy recovery of used packaging. Moreover, there are variations in the range of the participation of the industry.

Table 2 shows that in the last two years almost every European country established a regulation on the avoidance of packaging waste.

Manufacturers and dealers have to take back packaging and to develop measures for the achievement of targets in the field of waste management. According to the German ordinance:

a) packaging should be produced out of non-polluting materials;

b) packaging waste has to be avoided by minimisation of volume and weight and designed for refilling or reuse and re-utilisation.

This German regulation provides a time table for different types of packaging: transport packaging (December 1991), bundle packaging (April 1992) and sales packaging (January 1993).

As a practical solution for transport packaging many manufacturers and wholesalers/ retailers are practicing measures as described in the "Niederräder Declaration". This declaration was developed in the Working Group Manufacturers and Importers of Office Communication Systems (AG KHI) within VDMA and formulates measures for a decentralised joint regulation between manufacturers, dealers and customers, which are also applied in other branches.

The obligations to take back sales packaging are non-applicable for those manufacturers and distributors who join a collection and disposal system. In Germany the privately organised "Duales System Deutschland GmbH" was set up for this purpose and is starting to work with the aim of fulfilling the required collection and sorting quotas. A similar system is being built up in France by "Eco Emballage".

3.2. Waste from Used Electrical and Electronic Appliances

Major information technology companies in Europe had already recognised the problem of waste from used electrical and electronic appliances.

Well before the present public discussion about "electrical and electronic waste", e. g. in Germany and in the EC-project "priority waste streams", the IT Industry had begun to accept back used equipment for purposes of reuse, recycling or disposal.

In European countries the IT industry is active on different levels: there are IT companies which are already applying appropriate measures, other companies are collecting experience with pilot-projects and are developing plans for accepting back, reuse and recycling of used electrical and electronic appliances. The following paragraphs give an overview of general aspects, and information on activities in individual countries like France, Germany, Switzerland and the United Kingdom by way of example. *

The main sources of pressure for further developments of a changed way of handling used IT products are economy and environment. The economic pressure concerns landfill. Landfill costs are rising throughout the developed world, and will continue to do so in the years to come. The proposed EC Landfill Directive requiring improved standards of preparation, operation, and aftercare, and higher insurance costs, will increase landfill costs further.

Waste volume, and toxicity, are the two sources of environmental pressure. PCBs do occur in old appliances and have to be disposed with care. Cathode ray tubes from monitors and television sets, and batteries, are two other products requiring controlled disposal. Another problem with

* The report "End-of-life Electronic Equipment Waste" from R. Roy, CEST (Centre for Exploitation of Science and Technology, 5 Berners Road, London N1 OPW, United Kingdom, November 1991) which gives a thorough overview of the most important aspects of this matter, is the main basis of this section.

electronic equipment waste in general, however, is the volume, although this is not the main problem concerning IT-products: e. g. in Germany, Information Technology products amount only to about 10% of the product spectrum according to the planned German Electronic Scrap Ordinance. The most frequent products are consumer electronic appliances and household appliances.

Some other countries have started to address the problem by legislative means, too. The Tokyo City Council, for instance, has set up procedures for disposal of TV sets.

Figure 10 shows the rough structure of the proposed German "ordinance on the avoidance, reduction and recycling of waste from used electrical and electronic appliances", supposed to come into force on January 1, 1994. The dialogue between the electrical and electronic engineering industry concerned, its associations (VDMA, ZVEI and the German Information Technology Manufacturers' Association) and the Ministries for Environment and Economy, on the occasion of hearings and in position papers, has contributed - inter alia - to the important amendment that the obligation for taking back can be limited to the manufacturers own-brand products launched on the market after the ordinance comes into force.

Further important requirements which would be necessary for practicable regulations are, for instance:

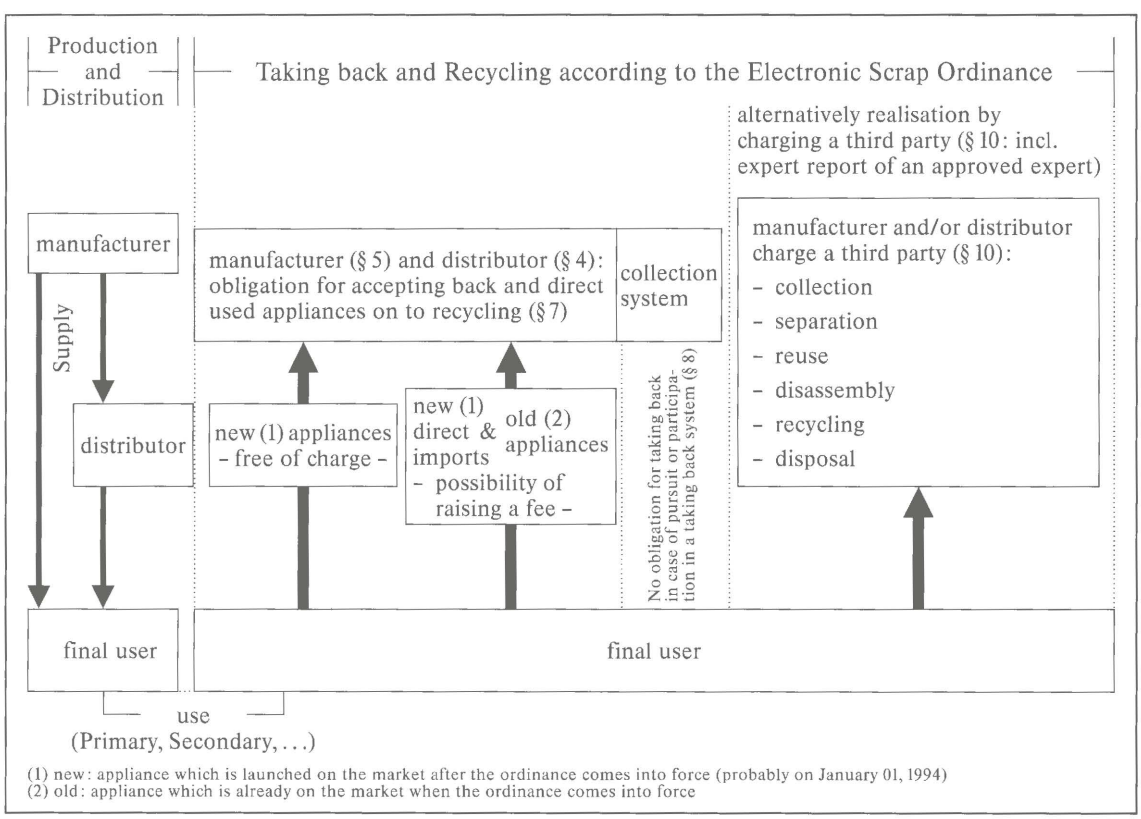


Figure 10: Rough Structure of the Draft German Electronic Scrap Ordinance

Source: EUROBIT (Corresponding to the Working Paper of the German Ministry for Environment, October 15, 1992)

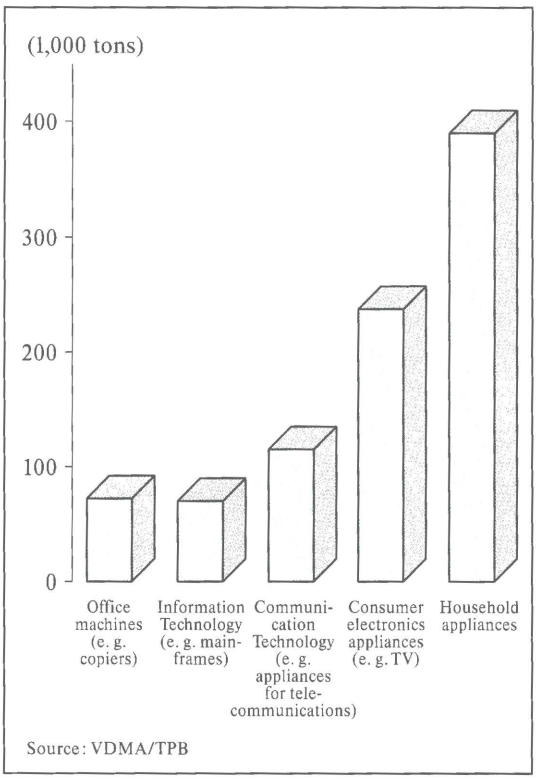
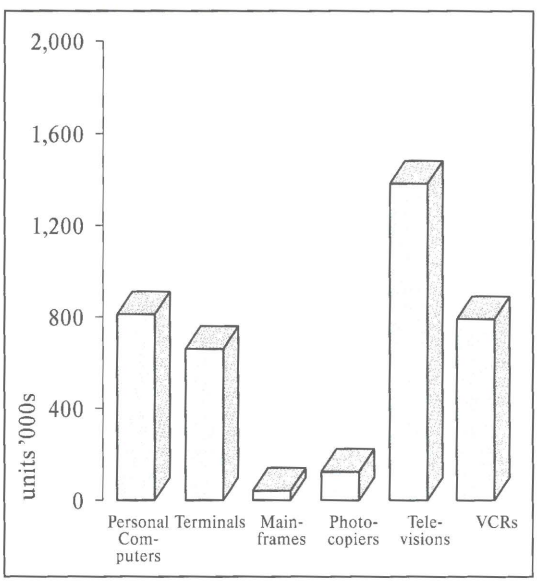


Figure 11: Estimated Amount of Selected Used Electrical and Electronic Appliances for Germany in 1992



Source: CEST Analysis

Figure 12: Forecast Annual Volume of UK Waste Stream from Electronics during Mid-90s

- inclusion of raw material manufacturers in the ordinance (e. g. plastics, glass, metal), with the obligation for recycling and disposal in order to close the cycle of material circulation;
- inclusion of the public authorities in the responsibility for final disposal of residues;
- realistic timescales for the obligations of the ordinance.

The German Government's action, and similar proposals by the Dutch Government, are supposed to have been models for similar legislative proposals of the EC. There are already strong similarities between the German and the EC packaging proposals; further, the EC has also proposed product-based "priority waste streams", recently for used electrical and electronic appliances (see paragraph 2.2.2 b).

3.2.1. Expected Quantity of Waste

Investigations on the estimated quantity of waste from used electrical and electronic appliances are known e. g. for Germany and the United Kingdom. The industry in France has presented figures in early 1993.

The German ZVEI estimates 1.5 million metric tons in 1994 for all electrical and electronic products covered by the planned German Electronic Scrap Ordinance, about 10% of it made up of IT products. See also the estimates of VDMA/TPB for 1992 in *Figure 11.*

With current consumption and disposal patterns, it is estimated that in the United Kingdom close to 6 million items of common electronic equipment will enter the annual waste stream from the UK's homes and offices. Estimated amounts from particular types of equipment are shown in *Figure 12.*

The amounts of typical material fractions in IT products are shown in *Table 3*. The main constituents are metal, plastics and glass from the cathode ray tubes. The most problematical fractions, such as plastics, glass from the cathode ray tubes and printed circuit boards, are described below.

3.2.2. Meeting the Challenge of a "Reverse Production"

There are some typical steps in the present procedure for the handling of used electrical and electronic appliances *(Figure 13)* which are implemented by Information Technology companies in Europe.

After collection and separation of used appliances, the reusable or - when possible - refurbished appliances or parts are removed. The remaining appliances are cannibalised to separate further reusable parts.

The Information Technology Industry has found many different ways of handling the further waste stream. Some companies realise the disassembling on their own, some companies engage specialised recycling- or disposal-companies or are cooperating with manufacturers of raw materials. This is the entrepreneurial decision of "Make or Buy" or of cooperation within the branch.

In France, Germany, Italy, Switzerland and the United Kingdom and in other European countries a growing number of specialised companies offer disassembly and further stages of recycling and disposal. E. g. in Germany some large-scale enterprises in the energy sector, raw material sector or the transportation sector offer consulting and realisation of recycling plans.

Furthermore, there are associations of small and medium sized enterprises in the recycling and disposal sector which specialise in electrical and electronic appliances.

Experts of IT companies are discussing requirements for recycling and disposal companies with the aim of agreement on quality standards, e. g. possibilities of an application of ISO 9000.*

In Switzerland the IGEE is elaborating technical "IGEE-Standards" for a minimal quality-level of recycling and disposal.

a) Collection

Collection and separation of components are usually the critical factors in recycling schemes.

There are significant logistic differences between residential users on the one hand, and large industrial and commercial users on the other. The latter can provide a uniform used product stream. Residential customers are a much more dispersed source of equipment with little uniformity in the product waste stream, which proves to be the major problem. It is useful to have a uniform product stream since the ability to obtain clean materials influences the next application for the reclaimed plastic, and therefore its market value.

The logistics of collection and further processing is a question that has to be resolved. It is likely that costs of transporting used equipment will require regional centres for processing.

b) Disassembly

After the used equipment has reached an internal or external processor, it has to be disassembled. The first dismantling occurs manually. An important question that will need to be resolved in an optimum recycling strategy is the efficient degree of disassembly and of shredding. Four problems have to be kept in mind: recovery of components (such as chips or other component parts which are currently more valuable than their scrap components); bonding between valuable metals (e. g. copper, gold) and the support

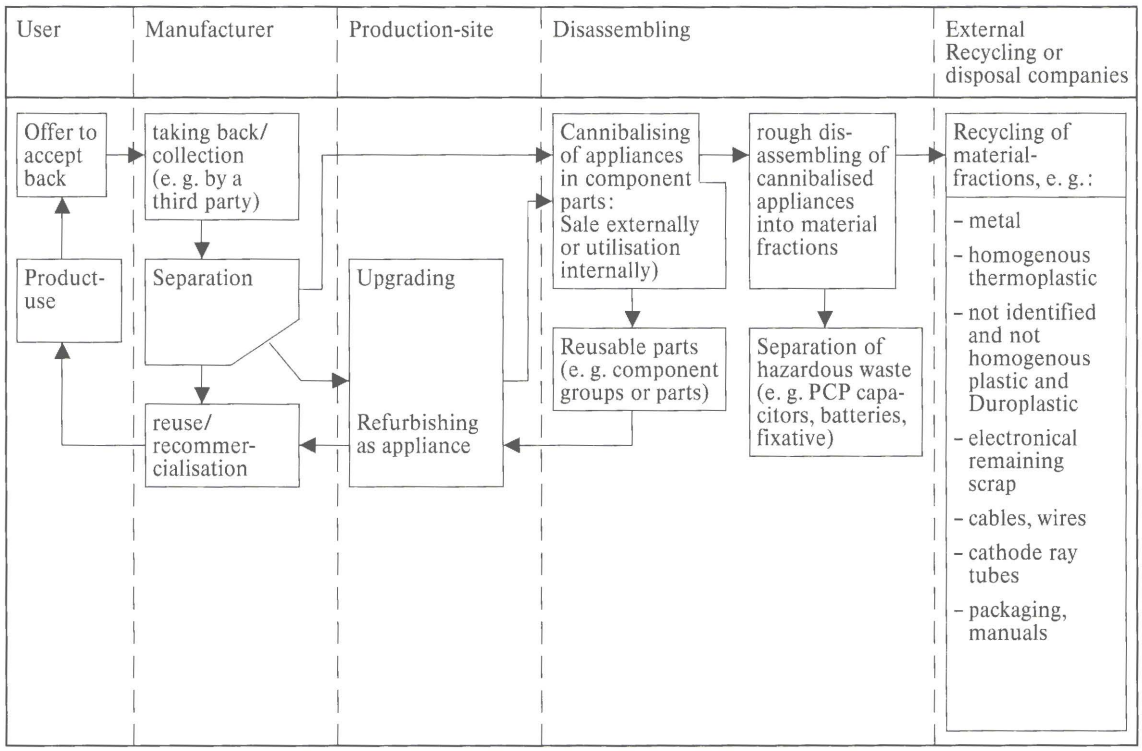
* International norm ISO 9000: "Quality management and quality assurance standards - Guidelines for selection and use"

Table 3: Material Fractions in Percent of Some Typical IT Products

Material Fractions in %					
Average of typical IT products		Mainframe System with peripherals		Example for a component part: Printed Circuit Boards	
Reusable Parts	2.6	Iron	55	Iron	6
Iron	67.0	Precious metal (incl. copper)	7	Precious metal compounds	9
Precious metal compounds	3.3	Aluminium	14	Non-ferrous metal	13
Non-ferrous metal	0.5	Plastics	16	Bromine	4
Aluminium	1.8	Cable	4	Plastics	19
Plastics	8.0	Others	4	Glass, ceramics, oxides	49
Cathode ray tubes	6.8				
Packaging, paper	9.5				
Hazardous (special) waste	0.5				

Source: IBM, 1991 Source: CEST, 1991 Source: Hopperdietzel et al., University of Erlangen-Nürnberg, 1992

Figure 13: Characteristic Steps in the Handling of Used Electrical and Electronic Appliances



Source: SNI

polymer (usually an epoxy sandwich sheet); separation of non-metallic material (e. g. polymers) and special disposal of potentially hazardous fractions.

c) Recycling

Precious metal parts, such as printed circuit boards, plug connections, etc., are processed by precious metal recovery companies or by copper works. The slag resulting from the smelting process can be reused as filling material, for instance in road construction. The remaining materials are reprocessed by smelting. In this way, the greater part of the appliances can be put back into economic circulation through reuse or recycling.

The creation of an economical and comprehensive system of disposal for the products of office and information technology, and a continued increase in the capacity of the materials employed to be recycled, will pay dividends. In this respect, new procedures must be developed, for instance for glass recycling, to permit cost-effective removal of coatings of cathode ray tubes containing toxic materials. In particular, an effective demand must be found for recycled glass material, e. g. as an additive in leaded glass or building materials.

Material recovery is the most attractive form of managing plastic waste, especially for the range of thermoplastics used in electronic equipment. In many instances, however, a certain amount of material may not be recyclable as polymer, or may have to be destroyed. The options available are chemical recycling, energy recovery by incineration and finally, landfill. *Figure 14* shows the hierarchy of plastics recycling processes.

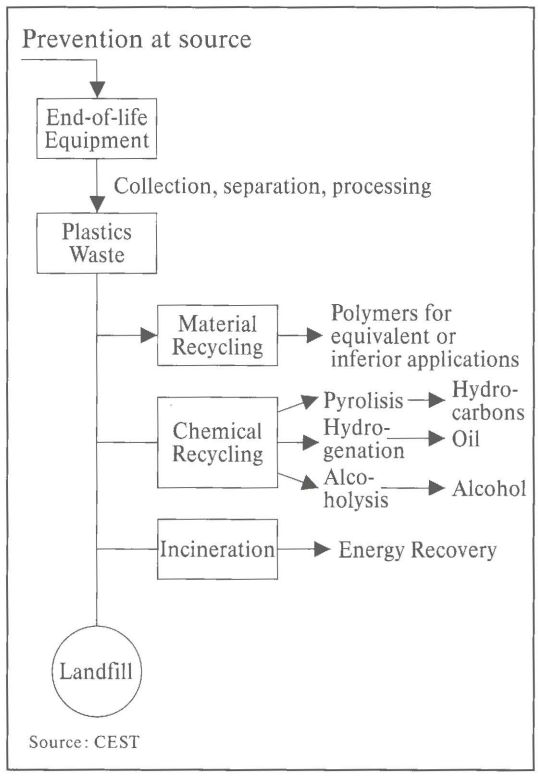


Figure 14: Hierarchy of Plastics Waste Management Paths

Sorting will be effective when principles of good design are incorporated, i. e. design for disassembly, use of few types of polymers and identification of polymer types. Characterisation, and separation, of polymers is an area where considerable research is urgently needed.

d) Final Disposal of Residues

Whatever strategy is employed for disposal of used equipment, be it landfill, material recycling including plastics, or incineration, a certain amount of residue will always remain. The aim should be to recover material (or energy) as far as possible and minimise the final residual waste.

Recycling of material from used mainframes, for example, leaves the recycler with capacitors and transformers, some of which contain PCBs, as well as old cells containing alkalis and heavy metals. This requires implementation of special procedures including notification to authorities before incineration or landfill in designated sites.

The equipment waste processor must therefore have as much knowledge as possible about the components in the equipment to achieve optimum recycling as well as to ensure safe disposal of potentially hazardous material.

e) Recycling Economics for IT Products

Main IT-manufacturers in Europe, particularly in Germany - where initiatives of IT manufacturers are well-known and requirements of the planned Electronic Scrap Ordinance are foreseeable - have offered a service to their customers to take back computer equipment for recovery, recycling and/or disposal, under the condition that a fee is charged to cover the difference between processing costs and the value of reclaimed material. Furthermore, the planned German ordinance provides that electrical and electronic appliances, which are introduced on the market after the coming into force of the ordinance (probably on January 1, 1994) have to be taken back free of charge for recycling and disposal.

Difficulties in the recycling of used electrical and electronic appliances arise from the following points:

- transportation is a major cost within recycling and depends on the location of the processing industry and end-users;
- special disposal techniques associated with processing hazardous substances in particular products are required;
- the prices of many precious and strategic metals, which constitute the most valuable elements of electronic scrap, have been declining and also often fluctuate widely;
- the market for many plastics components may only be theoretical, since they contain too many plastic types or additives for convenient recycling;
- glass from cathode ray tubes: recently there are patents for environmentally friendly processing of this glass, but economical applications have to be developed.

An integrated approach may be to evaluate environmental costs that are currently avoided. This raises questions about the internalisation of such costs, which could be the appropriate cost (rather than current prices) of landfill, and of recycled vs. virgin material. Cheap landfill is a good example of non-internalisation of environmental costs in the waste management industry. Recent EC legislative proposals on landfill will correct this to some extent. More stringent requirements for preparation, operation and aftercare, together with insurance requirements to cover liability, are expected to lead to a significant increase in disposal costs, making recycling economically more attractive.

f) National Organisations Dealing with Used Electrical and Electronic Appliances

Various projects for national systems for collection, recycling and disposal of used electrical and electronic appliances are on the way. The goal is to create a system e. g. for the whole IT branch or beyond it for several branches of the electrical, electronic and mechanical industry.

In Germany working groups of the industry and its associations are elaborating plans and measures for building up of branch or product specific systems. ZVEI established a task force

which deliberates measures and is setting up a corresponding association in 1993. VDMA started a study with a consultant who is presenting concrete proposals (final report in May 1993) for logistics, technologies and the financing of the best possible ecological solutions for collection and recycling systems of used electrical and electronic appliances.

In Switzerland the "Foundation Disposal Switzerland" ("Stiftung Entsorgung Schweiz" [S.EN.S.]) is building up a system for nation-wide disposal of electronic appliances.

In this system a nation-wide single disposal price will guarantee a balance between central (over-crowded) regions and border regions. The disposal price will include disposal processing, collection, transport from collection-sites to disposal-sites, controlling and supervising, and public relations.

In the United Kingdom the "Industry Council for Electronic and Electrical Equipment Recycling (ICER)", founded in 1992, is developing similar plans with participation of the IT Industry and other industries of the electrical and electronic sector, retailers and waste consultants. The mission of the ICER is to maximise the present and future benefits to industry and society of management of used electronic equipment waste, using a participative approach *(Figure 15)*.

The main reasons for a participative approach for the IT Industry in the United Kingdom as well as in other European countries are to:

- identify the problem and alternative future strategies in view of present barriers (technological, logistic, and economic);
- work towards the removal of the present barriers, and reduction of future uncertainties, by development of collaborative ventures;

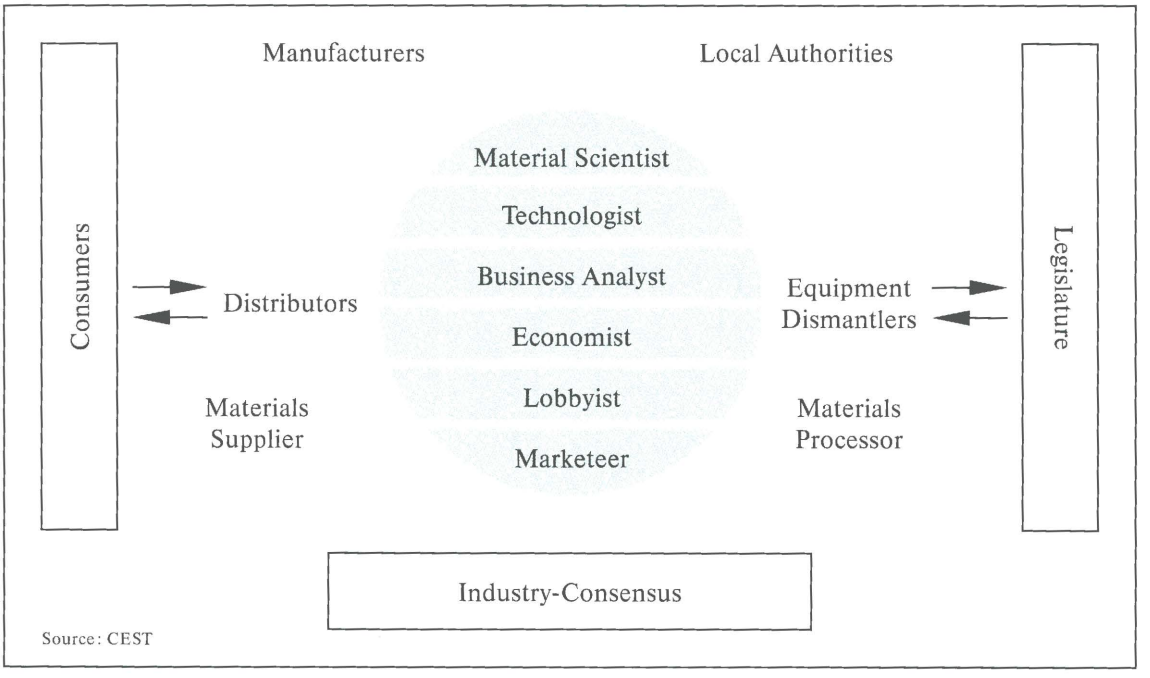


Figure 15: Participation, Skills and Interactions - Required for a Successful Initiative

- work towards the removal of the present barriers, and reduction of future uncertainties, by development of collaborative ventures;
- foster communication between industry, consumers and legislature;
- develop best practice for industry, and competitiveness for participating firms.

3.3. Environmental Labelling in Individual European Countries

The increasing environmental awareness is reflected in market surveys. In Germany, for instance, 62% of private households shop for environmentally friendly products, 23% do not shop specifically for environmentally friendly products, and only 15% of households are indifferent.

80% of households recognise the German environmental label "Blauer Engel" which has been endorsed to around 4,000 products with environmentally friendly properties. This label is one of the most well-known product labels of any kind.*

In Germany an environmental label for copiers has already been introduced in September 1991. Most of the manufacturers and importers of copiers have at least one copier which fulfills the requirements of this label. The German Jury Umweltzeichen announced enhancements in the requirements e. g. for toner for a next-three-year label period starting 1994. A further German environmental label for the "recycling- oriented construction of personal computers" is planned and also an Eco-label for printer/plotters.

In France, the environmental label "NF Environment" has been awarded since June 1992 by the "Association française de Normalisation".**

In cooperation with the industry concerned, with consumer and environmental associations, AFNOR elaborates proposals for technical criteria which have to be accepted by a scientific advisory board, the Comité de la Marque and the ministries for environment, for industry and for the consumer. The French Eco-label will be withdrawn in favour of an European Eco-label if the requirements of the latter meet the French requirements.

Since November 1992 a Dutch environmental label is awarded by an independent Foundation Environmental Label ("Stichting Milieukeur"). The foundation, created by the Dutch State, the industry and the consumer and environmental associations, awards the label, determines the awarding criteria and controls the use of the label.

* The German Environmental Label is jointly sponsored by
- the Jury Umweltzeichen - an independent panel made up of representatives from the scientific, business and environmental communities and from consumer organisations,
- the German Institute for Quality Assurance and Labelling (Deutsches Institut für Gütesicherung und Kennzeichnung e. V. - RAL), Bornheimer Straße 180, 5300 Bonn, Tel.: 0228/72614-0, and
- the Federal Environmental Agency (Umweltbundesamt), Bismarckplatz 1, 1000 Berlin 33, Tel.: 030/8903-0.

** AFNOR, Tour Europe, 92049 Paris de la Défense, Tel.: 0033 1/42 915555.

4. Conclusion

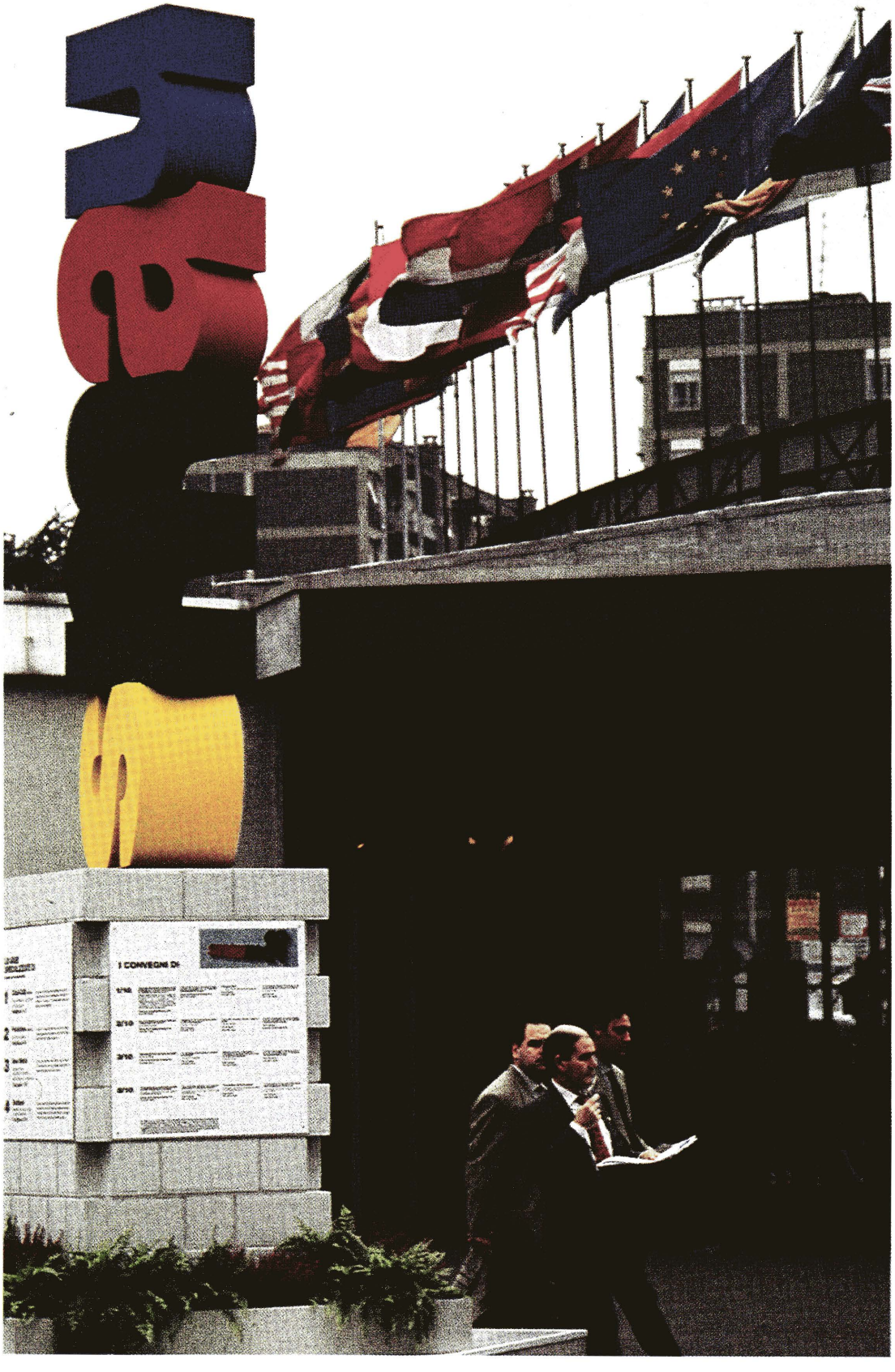
The IT Industry in Europe is meeting the challenges of an ecological modernisation. These challenges are not only a necessity, which cannot be postponed, for the conservation of conditions of life on earth - they also represent a great opportunity for the future of the IT Industry itself.

The IT Industry has already made important contributions to the harmonisation of economy and ecology and already put into practice measures of environmental management and ecological product policy some time before the corresponding legislation comes into force. IT manufacturers are working hard to develop and implement further steps in an integrated ecological company policy.

A precondition for further successes is a clear and homogenous framework under an EC-wide environmental policy, to prevent competitive distortions. As a signal for the achievement of this basic requirement, the EC Commission issued a communication on industrial competitiveness and environment in November 1992 and announced a wide range of appropriate strategies and measures. The European IT Industry and its association EUROBIT appreciate this initiative to foster further development and harmonisation of the framework of conditions in environmental policy.

Table 4: Glossary

AFNOR	Association francaise de normalisation
AG KHI	Working Group Manufacturers and Importers of Office Communications Systems within VDMA
BAUM	German Environmental Management Association (Bundesdeutscher Arbeitskreis für umweltbewußtes Management)
BCSD	Business Council for Sustainable Development
BDI	Federation of German Industries
CECD	Confédération européenne du commerce de détail
CEN	European Committee for Standardisation
CEST	Centre for Exploitation of Science and Technology, United Kingdom
EPMI	Working Committee European Printer Manufacturers and Importers within VDMA
EUROBIT	European Association of Manufacturers of Business Machines and Information Technology Industry
FEWITA	Federation of European Wholesale and International Trade Association
FV IT	German Information Technology Manufacturers' Association
GEDIS	Groupe européen des entreprises de distribution intégré
ICC	International Chamber of Commerce
ICER	Industry Council for Electronic and Electrical Equipment Recycling, United Kingdom
IEC	International Electrotechnical Committee
IGEE	Community of Interest for Electronic Appliances Disposal (Interessengemeinschaft Elektronik-apparate-Entsorgung, Schweiz)
ISO	International Organisation for Standardisation
ORGALIME	Liaison Group of the European Mechanical, Electrical, Electronic and Metalworking Industries
RAL	German Institute for Quality Assurance and Labelling
SENS	Foundation Disposal Switzerland (Stiftung Entsorgung Schweiz)
TPB	Töpfer Planning and Consulting (Consultant of VDMA)
UNCED	United Nations' Conference on Environment and Development
UNICE	Union of Industrial and Employer's Confederations of Europe
VDMA	German Machinery and Plant Manufacturers' Association
ZVEI	German Electrical and Electronic Engineering Industry Association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Part Three

Statistical Outlook

1. Introduction

This section presents statistics which illustrate the shape and structures behind the IT markets in Europe. The data and forecasts presented in this section have been jointly prepared by IDC and the EITO Task Force on the basis of the information available at the end of November 1992. The subject is presented in three main sections, preceded by an explanation of the methodologies behind the statistics. The first is concerned with the shape of the various national IT markets, within an international context, and the patterns of trade between them. The second section examines the individual markets structures with an eye on the competitive aspects, as well as comparative measures of IT penetration. In the third section, the focus switches to the role of technological advancement in altering the underlying economics of IT. Terms are defined at the end of the section.

2. Methodology

Government statistical bodies tend to model the world starting with the system of national accounts. Agreed classifications for industrial activity and trade thus become the measures against which markets are assessed. In many areas the restrictions imposed by such classifications and by the rigorous methods used to collect and process information are too great to make the resulting information useful to the business community. The IT market is a case in point, and the failure of the standard classifications to get to grips with the subject of software is a specific limitation.

This study is an attempt to shed light on some of the more important aspects of the European markets for information technology products (and services), including substantial elements of the associated market for office automation products.

The basis for the study is the marketplace. Thus, instead of defining the marketplace in terms of what is produced plus the balance of trade, IDC's research is aimed at measuring the market. Valuation is based upon the revenues paid to primary vendors, with research results cross-checked against a continuous programme of end-user interviews and distribution channel monitoring. Data on trade flows has also been collected, and matched as closely as possible to IDC's market oriented segmentation, since this data can tell us things about the position of Europe with respect to the World. What is presented then, is a comprehensive body of data which aims to illuminate the European IT Market, to cast light onto the situation of the markets' major players and the underlying competitive structures.

3. European IT Markets and Patterns of Trade

For the purpose of this study, with an emphasis on the industry supplying goods and services in return for payment, we deal with the value of revenues paid to primary vendors for information technology goods and services. For an expanded discussion of the principles implicit

within this study readers are referred to the section on definitions, which appears later in this volume.

All forecast data is prepared in local currencies and subsequently converted into constant 1991 ECU using the exchange rates listed at the end of the definitions section. Growth rates therefore correspond to local currency growth rates. No adjustment is made for the effects of inflation.

In terms of classes of product, again a full account appears later in this volume. Here we note that the definition of the hardware marketplace has been expanded beyond the traditional IT systems arena, to include a broad category of office hardware technologies such as photocopiers, typewriters and calculating machines. Specifically not included in the study are the various classes of facsimile machines and services and consumables in support of office equipment. Software and services as measured in this study include a proportion of value-added network services such as are typically supplied by software and services vendors, but stops short of inclusion of a broad measure of the general telecommunications business.

In terms of geography, the presentation used here is based firmly upon market realities. As the rate of growth in information technology markets has reduced substantially, vendors have been encouraged to pursue opportunities in markets remote from their traditional operations. This is reflected in increased interest in the smaller EC markets, such as Greece, Ireland and Portugal, and further afield in Eastern Europe. As research continues into these markets and as the markets themselves develop, the level of detail at which information is meaningful will change. Until then, the basis of segmentation for some of these countries falls short of that used in the established markets. This is reflected in the presentation which follows. Throughout the statistical section Eastern Europe is considered to refer to the former Czechoslovakia, Hungary, Poland and the former Soviet Union. The EFTA is represented by data on Austria, Finland, Norway, Sweden and Switzerland (Liechtenstein and Iceland are not included). The heading EC refers to Belgium and Luxembourg, Denmark, France, Germany, Greece, Italy, the Republic of Ireland, the Netherlands, Spain, Portugal, and the UK.

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6. The European IT Markets

The rapid growth of IT markets which was so much a feature of the global economy over the past decade and more, came to a sudden halt in the early 1990s. The manner in which the European IT market decelerated is well illustrated in *figure 1.* One side effect of the new growth paradigm, enabled to a large extent by the dismantling of political barriers between Eastern & Western Europe, has been an increased interest in new markets. Whilst there are undoubtedly problems in trading in the former Eastern European states (this is discussed in detail in Part Two, The Information Technology Markets of Eastern Europe), the considerable opportunities for increased application of IT in new areas is well demonstrated by the explosive growth of the Spanish IT market following membership of the EC. In this section the balance between the sophisticated IT markets of Western Europe and the emerging markets is illustrated and put into international context.

Table 1 shows the composition of the Worldwide market for IT by region, as defined for the purposes of this study. In 1992 the European market, comprising the EC and EFTA states, accounted for 36.5% of the World market for IT, with the US as the second largest market with 35.3%, and Japan third largest with 17.4% of the total. Over the two year period to the end of 1994, differential rates of market development will result in the share of the total ascribed to the US and European markets diminishing slightly, as the assorted markets of the Asia/Pacific and other regions expand their share of the total consumption market. By 1994, the European IT market will account for 35.4% of the total, the US market will account for 34.9% of the same total, and the emerging Eastern European markets will have expanded their share of the World market from 0.7% to 0.9%. *Figure 2* shows the composition of the Worldwide IT market by class of product.

Industry executives and those professionally engaged in monitoring the IT industry have been made increasingly aware of the close ties between the fortunes of the industry and the general economic health of the major buying nations. Although during some phases of the rapid development of the IT industry, economic weakness has acted as a catalyst for sales, as companies have automated manual functions, this is no longer the case. It is therefore advisable to review briefly the economic background against which the forecasts presented here should be considered.

Low economic growth and decelerating inflation have been a distinctive feature of the global economic scene in the early 1990s. The US economy exhibited considerable weakness during 1990 and 1991, and 1992 failed to bring a substantial and robust recovery. The progress of 1992 also saw developing weakness in both the German and Japanese economies. In Europe, economic growth in 1992 fell below 1991 levels, and no significant recovery is expected in 1993. Of the 4 largest European economies, only the UK is expected to achieve a modest increase in real growth in 1993: Germany, France and Italy are expected to return lower real growth rates. However conditions are forecast to improve considerably during the second half of 1993, and prospects for 1994 are far better. An important assumption behind the current forecasts (economic as well as IT) is that the slowdown in growth in Germany will prove to be of very short duration. Thus, the scene against which the current IT forecasts must be judged can be characterised in terms of weak economic growth in 1992, little or no increase in the rate of growth in 1993, but a significant recovery in 1994.

The 1992 market for information technology products in Western Europe is valued at ECU 128 billion. Of this, ECU 110 billion is attributed to EC member states, and the remaining ECU

18 billion is attributed to EFTA states (for the purposes of this study, Iceland and Liechtenstein are not included). Czechoslovakia, Poland, Hungary and the former Soviet Union (not included in the Western European total quoted above) considered together would add a further ECU 2.5 billion to the total. By 1994 the combination of the EC and EFTA market forecasts is expected to reach ECU 143 billion, an increase of ECU 15 billion over two years; but Eastern European markets are only expected to offer an addition opportunity equivalent to ECU 1 billion over the same period. *Table 2* shows the overall value of the IT markets in the various EC and EFTA states over the study period. The relative proportions that the EFTA, EC and Eastern European states comprise of the total continental IT market are illustrated in *figure 3*. More detailed information on the IT market value in the major regions and the individual countries, including comprehensive details by class of product, are given in *tables 3* to *26*. Supplementary data on the number of units shipped and on the number of units installed are given, where available, in *tables 27* to *63*.

The growth potential of the IT market in 1993 is limited by the expected rate of economic recovery in Europe. However, in spite of the relatively unexciting economic conditions expected, the prognosis for the IT market in 1993 is for a modest recovery, gathering momentum and accelerating into 1994. The core markets in Europe (excluding Eastern Europe) are expected to generate an additional ECU 5.5 billion in 1993, equivalent to a growth rate of 4.3%. Readers are referred back to *figure 1* where the forecast profile is illustrated.

By class of business, the largest proportion of the 1992 market is attributed to various classes of IT services (office services or servicing of office equipment is expressly not included in this study). These categories will comprise 37.8% of the total market in 1992. The next largest sector is computer hardware, which comprises 34.8% of the 1992 total, followed by software products, 15.0% of the 1992 total, and finally, office equipment with 10.2% of the total. Even over a two year period from 1992 to 1994, the European IT market is expected to experience a further transformation in its overall disposition. Differential growth is forecast for the software and service sectors of the market place, leading to the market proportions illustrated in *figure 4*. The change in market proportions illustrated over this relatively short period of time is part of a longer term process, which has already seen the software and services sectors increase their share of the total considerably over the past five years.

The compound annual growth rates for the major classes of business from 1992 to 1994 are shown in *figure 5*, and detailed examination of the forecasts presented will reveal that although overall growth prospects are limited, there are product or service oriented segments of the market place where considerable growth can be expected. This fact emphasises the importance of past strategic decisions in determining the short term growth potential for IT vendors currently active in Europe, and on a longer time scale, the challenges of profitably reorienting the business to meet the changing requirements of the market place.

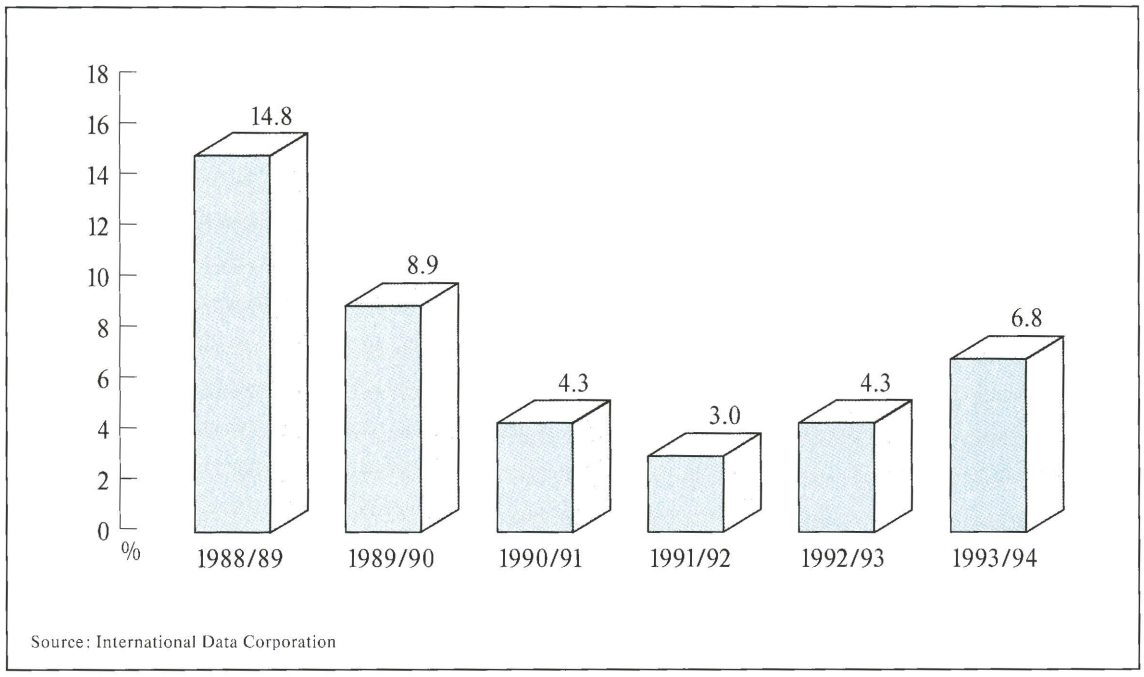
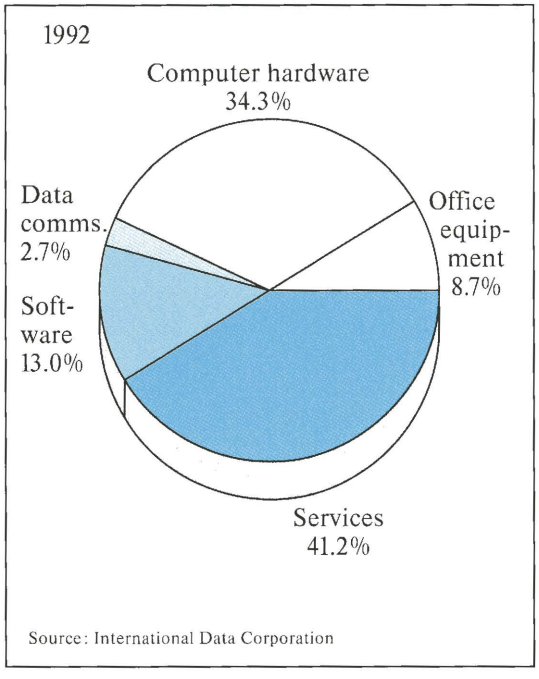


Figure 1
EC + EFTA
IT Market
% Annual Growth



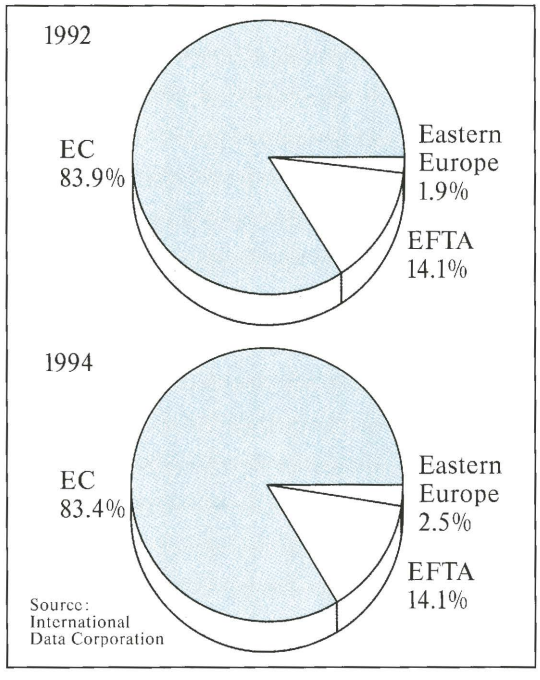


Figure 2
World IT Market
by Product 1992

Figure 3
European IT Markets
by Region
Proportions of Total

Figure 4
EC + EFTA
IT Market Proportions
by Class of Business

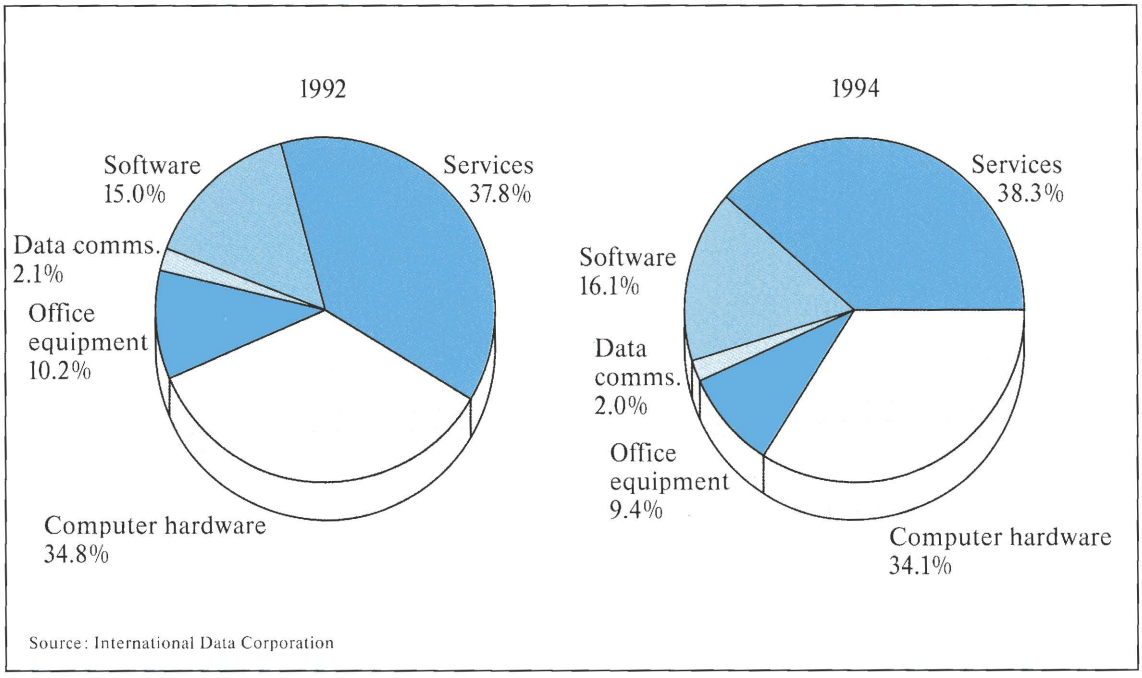
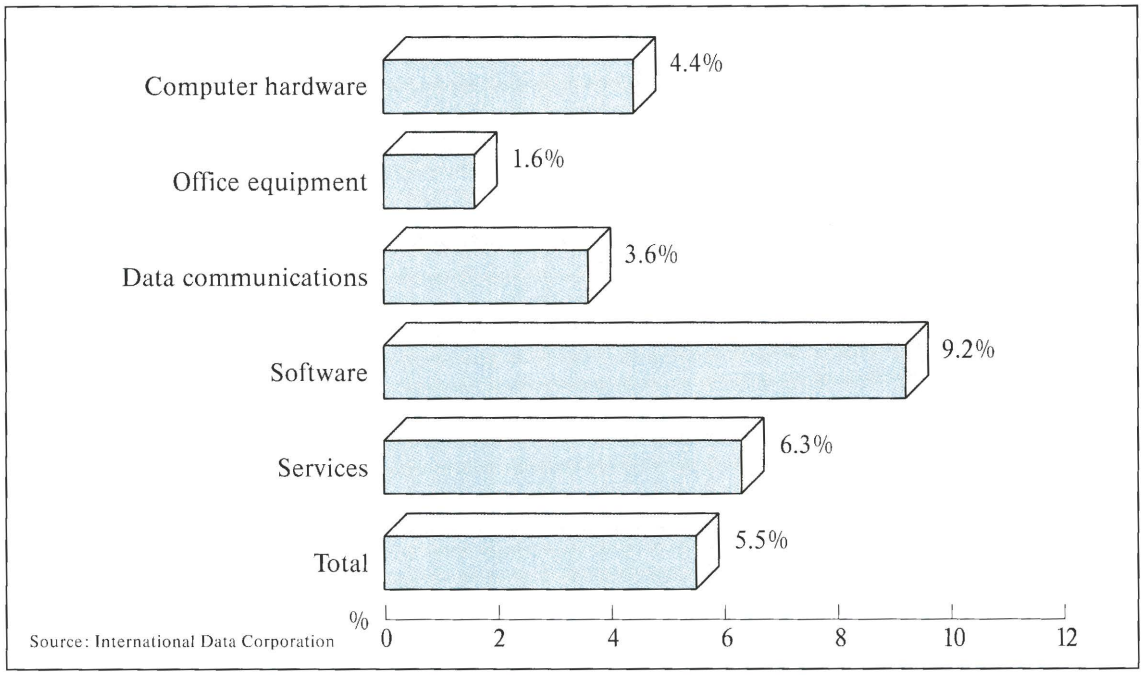


Figure 5
EC + EFTA
IT Market 1992-1994
Compound Annual
Growth



Region	1992	%	1994	%
EC	109,734	31.2	122,093	30.4
EFTA	18,450	5.2	20,632	5.1
EC + EFTA	128,184	36.5	142,725	35.6
Eastern Europe	2,534	0.7	3,678	0.9
US	124,198	35.3	140,588	35.0
Japan	61,084	17.4	71,324	17.8
4 tigers	4,402	1.3	5,500	1.4
ROW	31,033	8.8	37,378	9.3
World	351,435	100.0	401,194	100.0

Table 1
World IT Market
by Region
(ECU Millions)

Europe	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Belgium/Luxembourg	3,674	3,892	4,065	4,261	4,511	5.2	5.3
Denmark	3,136	3,231	3,320	3,483	3,699	2.9	5.5
France	20,965	21,591	21,931	22,365	23,634	2.3	3.8
Germany	26,622	28,660	30,003	31,656	33,714	6.2	6.0
Greece	356	396	451	524	616	12.5	16.9
Ireland	555	583	621	664	701	5.8	6.3
Italy	13,028	13,767	14,406	15,007	15,842	5.2	4.9
Netherlands	6,673	6,954	7,208	7,583	8,399	3.9	8.0
Portugal	631	761	901	1,071	1,331	19.5	21.5
Spain	5,802	6,362	6,698	7,093	7,719	7.4	7.4
UK	19,701	19,885	20,130	20,723	21,926	1.1	4.4
EC	101,143	106,083	109,734	114,429	122,093	4.2	5.5
Austria	2,353	2,386	2,506	2,653	2,926	3.2	8.0
Finland	2,326	2,271	2,261	2,319	2,569	- 1.4	6.6
Norway	2,447	2,602	2,564	2,640	2,747	2.4	3.5
Sweden	5,445	5,555	5,416	5,648	5,915	- 0.3	4.5
Switzerland	5,501	5,509	5,704	5,949	6,475	1.8	6.5
EFTA	18,072	18,324	18,450	19,210	20,632	1.0	5.7
EC + EFTA	119,215	124,407	128,184	133,639	142,725	3.7	5.5

Table 2
European IT Market
by Country
(ECU Millions)

Table 3
EC
IT Market Value
(ECU Millions)

EC	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large	7,375	6,720	6,187	5,818	5,857	- 8.4	- 2.7
Medium	5,972	5,768	5,324	5,028	5,055	- 5.6	- 2.6
Small	5,212	5,384	5,313	5,255	5,318	1.0	0.0
Workstations	1,435	1,742	1,941	2,267	2,743	16.3	18.9
PCs	16,289	15,994	15,090	15,619	17,725	- 3.8	8.4
PC printers	4,042	4,413	4,706	4,970	5,183	7.9	5.0
Computer hardware	40,325	40,021	38,560	38,957	41,882	- 2.2	4.2
Typewriters	1,163	1,158	1,072	1,030	936	- 4.0	- 6.5
Calculators	854	883	918	951	964	3.7	2.5
Copiers	5,128	5,254	5,502	5,698	5,841	3.6	3.0
Other Office Equipment	3,644	3,721	3,821	3,917	3,948	2.4	1.7
Office equipment	10,789	11,016	11,312	11,597	11,690	2.4	1.7
Data communications hardware	1,971	2,208	2,388	2,497	2,587	10.1	4.1
Software products	13,100	14,819	16,533	18,041	19,663	12.3	9.1
Professional services	16,843	18,790	20,726	22,378	24,414	10.9	8.5
Processing & network services	7,229	7,754	8,340	8,840	9,455	7.4	6.5
Hardware maintenance & support services	10,886	11,476	11,875	12,119	12,401	4.4	2.2
Other services	18,115	19,230	20,215	20,959	21,856	5.6	4.0
All services	34,958	38,019	40,941	43,337	46,271	8.2	6.3
Total	101,143	106,083	109,734	114,429	122,093	4.2	5.5

EFTA	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large	1,128	935	917	883	905	- 9.8	- 0.7
Medium	787	741	672	666	678	- 7.6	0.4
Small	828	731	735	759	793	- 5.8	3.9
Workstations	290	330	354	419	516	10.5	20.7
PCs	3,220	3,123	2,640	2,609	2,927	- 9.5	5.3
PC printers	671	725	791	869	942	8.6	9.1
Computer hardware	6,924	6,584	6,109	6,205	6,760	- 6.1	5.2
Typewriters	159	168	148	136	119	- 3.3	- 10.6
Calculators	127	126	129	134	134	0.6	1.8
Copiers	830	856	889	896	937	3.5	2.6
Other Office Equipment	569	587	595	595	606	2.2	1.0
Office equipment	1,686	1,738	1,762	1,762	1,796	2.2	1.0
Data communications hardware	281	338	341	337	345	10.2	0.5
Software products	2,307	2,524	2,719	2,979	3,285	8.6	9.9
Professional services	3,041	3,278	3,474	3,699	3,968	6.9	6.9
Processing & network services	1,773	1,854	1,938	2,099	2,300	4.6	8.9
Hardware maintenance & support services	2,060	2,008	2,107	2,129	2,179	1.1	1.7
Other services	3,832	3,862	4,045	4,228	4,478	2.7	5.2
All services	6,874	7,139	7,519	7,927	8,447	4.6	6.0
Total	18,072	18,324	18,450	19,210	20,632	1.0	5.7

Table 4
EFTA
IT Market Value
(ECU Millions)

Table 5
EC + EFTA
IT Market Value
(ECU Millions)

EC + EFTA	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large	8,503	7,655	7,104	6,701	6,762	- 8.6	- 2.4
Medium	6,759	6,509	5,996	5,694	5,733	- 5.8	- 2.2
Small	6,040	6,115	6,048	6,014	6,111	0.1	0.5
Workstations	1,725	2,071	2,295	2,686	3,259	15.3	19.2
PCs	19,509	19,117	17,730	18,228	20,652	- 4.7	7.9
PC printers	4,713	5,138	5,497	5,839	6,125	8.0	5.6
Computer hardware	47,249	46,605	44,670	45,161	48,642	- 2.8	4.4
Typewriters	1,322	1,327	1,220	1,167	1,055	- 3.9	- 7.0
Calculators	981	1,009	1,047	1,086	1,098	3.3	2.4
Copiers	5,958	6,111	6,391	6,594	6,778	3.6	3.0
Other Office Equipment	4,213	4,308	4,416	4,512	4,555	2.4	1.6
Office equipment	12,475	12,754	13,074	13,359	13,486	2.4	1.6
Data communications hardware	2,252	2,546	2,729	2,835	2,932	10.1	3.6
Software products	15,407	17,343	19,252	21,019	22,948	11.8	9.2
Professional services	19,885	22,067	24,200	26,077	28,382	10.3	8.3
Processing & network services	9,001	9,608	10,278	10,939	11,755	6.9	6.9
Hardware maintenance & support services	12,946	13,484	13,982	14,248	14,580	3.9	2.1
Other services	21,947	23,091	24,260	25,187	26,335	5.1	4.2
All services	41,832	45,159	48,460	51,264	54,717	7.6	6.3
Total	119,215	124,407	128,184	133,639	142,725	3.7	5.5

Austria	1990	1991	1992	1993	1994	CAGR 90–92 %	CAGR 92–94 %
Large	197	151	153	147	150	- 11.8	- 1.1
Medium	195	164	139	139	144	- 15.5	1.5
Small	173	179	182	187	197	2.5	3.9
Workstation	36	46	55	70	97	22.5	33.4
PCs - professional market	285	251	248	275	339	- 6.8	16.9
PCs - home market	41	38	46	53	62	5.7	16.2
PC printers	116	125	131	139	147	6.6	6.0
Computer hardware	1,044	953	955	1,012	1,136	- 4.4	9.1
Typewriters	23	23	21	20	17	- 5.1	- 10.2
Calculators	17	18	20	21	22	9.3	4.9
Copiers	107	105	100	102	102	- 3.6	1.3
Other Office Equipment	75	74	72	73	72	- 2.3	0.2
Office equipment	222	220	212	216	213	- 2.3	0.2
LAN hardware	10	13	15	11	12	22.8	- 9.1
Other data communications	32	36	38	36	37	8.6	- 1.5
Data communications hardware	42	50	53	47	49	12.0	- 3.5
Systems/utilities	108	112	122	129	136	6.3	5.7
Application tools	87	99	114	129	143	14.5	12.0
Application solutions	127	157	180	207	243	18.9	16.2
Software products	322	368	415	464	521	13.6	12.0
IT consulting	50	59	70	76	87	17.9	11.7
Contract programming	130	149	170	187	213	14.7	11.7
Staff delegation	57	65	72	76	86	12.6	9.5
Education & training	50	58	66	71	82	15.0	11.3
Systems & network operation	14	16	18	17	20	13.9	4.9
Professional services	301	347	397	427	488	14.8	10.9
Processing services	151	155	164	169	178	4.4	4.2
Network services	15	20	24	24	28	25.7	8.0
Hardware maintenance & support services	257	273	286	294	312	5.6	4.4
Other services	423	449	475	487	518	6.0	4.5
All services	724	796	871	914	1,006	9.7	7.5
Total	2,353	2,386	2,506	2,653	2,926	3.2	8.0

Table 6
Austria
IT Market Value
(ECU Millions)

Table 7
Belgium/Luxembourg
IT Market Value
(ECU Millions)

Belgium/Luxembourg	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large	279	269	264	255	256	- 2.9	- 1.5
Medium	169	203	206	206	210	10.3	1.0
Small	191	201	205	215	225	3.6	4.6
Workstation	41	46	60	82	109	21.3	34.8
PCs - professional market	497	485	474	457	479	- 2.3	0.5
PCs - home market	69	69	63	66	72	- 4.2	6.8
PC printers	191	206	215	220	227	6.3	2.6
Computer hardware	1,436	1,479	1,487	1,500	1,577	1.8	3.0
Typewriters	40	37	32	26	24	- 9.6	- 13.3
Calculators	28	28	26	26	27	- 4.1	3.0
Copiers	160	168	178	191	195	5.3	4.9
Other Office Equipment	116	119	120	124	126	1.8	2.4
Office equipment	344	352	356	367	373	1.8	2.4
LAN hardware	19	25	26	27	26	18.9	- 1.1
Other data communications	27	31	33	34	35	10.3	3.7
Data communications hardware	45	56	59	61	61	13.9	1.6
Systems/utilities	164	173	192	187	218	8.4	6.6
Application tools	134	158	183	226	244	17.0	15.4
Application solutions	183	207	235	281	303	13.3	13.6
Software products	480	538	610	694	765	12.7	12.0
IT consulting	113	122	131	140	149	7.5	6.7
Contract programming	269	282	299	314	330	5.5	5.0
Staff delegation	85	91	96	101	107	6.2	5.5
Education & training	89	99	109	121	134	10.7	10.6
Systems & network operation	58	68	81	94	110	19.0	16.0
Professional services	614	662	717	771	829	8.1	7.5
Processing services	330	344	357	372	385	4.0	3.8
Network services	28	36	43	49	53	24.9	10.7
Hardware maintenance & support services	397	424	436	447	468	4.8	3.7
Other services	754	805	836	867	906	5.3	4.1
All services	1,368	1,468	1,553	1,638	1,735	6.5	5.7
Total	3,674	3,892	4,065	4,261	4,511	5.2	5.3

Denmark	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large	287	228	219	206	214	- 12.7	- 1.1
Medium	136	149	135	134	138	- 0.2	0.9
Small	109	130	134	140	148	10.6	5.1
Workstation	31	28	31	35	47	0.1	23.4
PCs - professional market	411	410	365	361	359	- 5.7	- 0.9
PCs - home market	45	31	43	49	53	- 2.7	11.6
PC printers	107	116	126	137	146	8.2	7.8
Computer hardware	1,126	1,092	1,052	1,063	1,104	- 3.3	2.4
Typewriters	32	29	25	24	21	- 11.5	-7.0
Calculators	22	22	21	22	22	- 1.4	0.9
Copiers	134	145	162	177	202	9.8	11.6
Other Office Equipment	96	100	106	114	125	5.2	8.5
Office equipment	284	296	314	337	370	5.2	8.5
LAN hardware	24	30	33	35	33	16.0	- 0.2
Other data communications	41	47	49	51	53	9.1	3.6
Data communications hardware	66	77	82	86	85	11.7	2.1
Systems/utilities	74	80	87	95	104	8.8	8.9
Application tools	104	117	127	135	145	10.3	6.8
Application solutions	188	209	229	248	265	10.4	7.7
Software products	366	406	443	478	514	10.0	7.7
IT consulting	95	100	106	114	120	5.7	6.4
Contract programming	179	187	195	205	215	4.3	5.1
Staff delegation	95	100	106	114	120	5.7	6.4
Education & training	93	96	96	100	109	1.7	6.5
Systems & network operation	27	31	36	42	54	15.8	22.5
Professional services	488	513	539	576	618	5.0	7.1
Processing services	394	423	454	499	550	7.3	10.0
Network services	47	54	60	64	71	13.2	9.0
Hardware maintenance & support services	365	370	376	381	386	1.5	1.4
Other services	806	847	890	944	1,007	5.1	6.4
All services	1,294	1,360	1,429	1,520	1,626	5.1	6.7
Total	3,136	3,231	3,320	3,483	3,699	2.9	5.5

Table 8
Denmark
IT Market Value
(ECU Millions)

Table 9
Finland
IT Market Value
(ECU Millions)

Finland	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large	96	80	78	74	75	- 9.9	- 1.9
Medium	66	78	66	66	66	0.0	0.4
Small	92	92	94	99	104	1.1	4.9
Workstation	34	31	31	36	44	- 3.5	19.1
PCs - professional market	465	391	352	344	465	- 13.0	15.0
PCs - home market	29	18	15	16	26	- 29.3	33.3
PC printers	78	84	92	109	128	8.8	17.7
Computer hardware	859	774	727	744	908	- 8.0	11.7
Typewriters	24	23	19	16	14	- 12.0	- 13.4
Calculators	17	17	18	17	18	2.8	0.2
Copiers	118	123	135	137	144	6.9	3.2
Other Office Equipment	81	83	88	87	90	3.8	1.2
Office equipment	241	246	259	259	266	3.8	1.2
LAN hardware	19	27	30	31	30	24.9	0.3
Other data communications	16	19	20	21	22	12.3	4.0
Data communications hardware	36	46	51	53	53	19.3	1.8
Systems/utilities	54	55	54	57	63	0.2	7.6
Application tools	80	83	84	87	94	2.4	5.7
Application solutions	140	142	146	153	165	2.1	6.1
Software products	275	280	285	296	322	1.8	6.3
IT consulting	83	83	82	84	89	- 0.5	4.4
Contract programming	132	135	134	134	138	0.6	1.5
Staff delegation	75	73	70	70	70	- 3.3	0.0
Education & training	58	55	51	52	56	- 5.8	4.7
Systems & network operation	20	24	29	35	41	20.0	19.0
Professional services	367	371	365	374	394	- 0.2	3.8
Processing services	245	250	265	283	305	4.1	7.2
Network services	19	22	26	27	30	15.6	6.9
Hardware maintenance & support services	285	280	282	283	293	- 0.6	2.0
Other services	549	553	573	593	627	2.2	4.6
All services	916	924	938	967	1.021	1.2	4.3
Total	2,326	2,271	2,261	2,319	2,569	- 1.4	6.6

France	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large	1,456	1,371	1,295	1,190	1,180	- 5.7	- 4.5
Medium	1,262	1,138	1,057	1,001	940	- 8.5	- 5.7
Small	986	953	910	897	870	- 3.9	- 2.2
Workstation	294	338	365	390	420	11.4	7.2
PCs - professional market	3,130	2,905	2,701	2,615	3,136	- 7.1	7.8
PCs - home market	278	296	296	322	414	3.2	18.3
PC printers	734	792	833	876	918	6.6	4.9
Computer hardware	**8,139**	**7,793**	**7,456**	**7,292**	**7,877**	**- 4.3**	**2.8**
Typewriters	186	185	160	147	125	- 7.4	- 11.4
Calculators	144	155	158	152	166	4.7	2.5
Copiers	944	978	1,018	1,078	1,175	3.9	7.4
Other Office Equipment	650	672	681	702	748	2.4	4.8
Office equipment	**1,924**	**1,990**	**2,017**	**2,080**	**2,214**	**2.4**	**4.8**
LAN hardware	92	116	131	147	153	19.8	7.9
Other data communications	312	336	370	405	436	9.0	8.6
Data communications hardware	**403**	**452**	**502**	**552**	**589**	**11.5**	**8.4**
Systems/utilities	821	843	847	877	926	1.5	4.6
Application tools	684	816	876	939	1,005	13.1	7.1
Application solutions	907	1,061	1,197	1,270	1,358	14.9	6.5
Software products	**2,413**	**2,721**	**2,919**	**3,086**	**3,288**	**10.0**	**6.1**
IT consulting	962	996	1,031	1,022	1,055	3.5	1.2
Contract programming	1,586	1,713	1,773	1,790	1,804	5.7	0.9
Staff delegation	868	903	900	936	974	1.8	4.0
Education & training	359	405	446	470	480	11.4	3.8
Systems & network operation	310	372	432	506	597	18.1	17.5
Professional services	4,086	4,390	4,581	4,724	4,910	5.9	3.5
Processing services	1,335	1,396	1,482	1,554	1,631	5.4	4.9
Network services	159	178	205	240	297	13.6	20.4
Hardware maintenance & support services	2,506	2,671	2,769	2,836	2,828	5.1	1.1
Other services	4,000	4,245	4,456	4,629	4,756	5.5	3.3
All services	**8,085**	**8,634**	**9,037**	**9,354**	**9,665**	**5.7**	**3.4**
Total	20,965	21,591	21,931	22,365	23,634	2.3	3.8

Table 10
France
IT Market Value
(ECU Millions)

Table 11
Germany
IT Market Value
(ECU Millions)

Germany	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large	2,468	2,221	1,933	1,776	1,758	- 11.5	- 4.7
Medium	1,418	1,432	1,276	1,173	1,179	- 5.2	- 3.9
Small	1,215	1,504	1,411	1,372	1,360	7.8	- 1.8
Workstation	464	580	650	829	1,057	18.4	27.5
PCs - professional market	3,262	3,154	3,110	3,506	3,942	- 2.3	12.6
PCs - home market	834	1,001	1,051	1,179	1,238	12.2	8.5
PC printers	1,277	1,379	1,466	1,533	1,541	7.2	2.5
Computer hardware	10,938	11,272	10,898	11,368	12,074	- 0.2	5.3
Typewriters	349	361	375	385	379	3.7	0.6
Calculators	256	269	289	295	293	6.2	0.7
Copiers	1,216	1,254	1,375	1,407	1,414	6.3	1.4
Other Office Equipment	929	961	1,040	1,064	1,064	5.8	1.1
Office equipment	2,749	2,844	3,078	3,151	3,149	5.8	1.1
LAN hardware	143	187	214	216	222	22.6	1.8
Other data communications	373	388	409	413	427	4.8	2.2
Data communications hardware	515	574	624	628	650	10.0	2.1
Systems/utilities	837	930	1,041	1,113	1,159	11.5	5.5
Application tools	906	1,152	1,330	1,455	1,631	21.2	10.7
Application solutions	1,337	1,559	1,823	2,074	2,323	16.7	12.9
Software products	3,080	3,641	4,194	4,642	5,112	16.7	10.4
IT consulting	724	840	943	1,000	1,090	14.1	7.5
Contract programming	1,890	2,173	2,499	2,723	3,165	15.0	12.5
Staff delegation	633	689	758	751	816	9.4	3.8
Education & training	995	1,174	1,272	1,361	1,474	13.1	7.6
Systems & network operation	67	86	107	119	155	26.1	20.3
Professional services	4,309	4,962	5,579	5,953	6,699	13.8	9.6
Processing services	1,783	1,910	2,026	2,117	2,216	6.6	4.6
Network services	126	150	177	199	235	18.9	15.1
Hardware maintenance & support services	3,122	3,306	3,427	3,598	3,579	4.8	2.2
Other services	5,030	5,366	5,631	5,914	6,030	5.8	3.5
All services	9,339	10,328	11,210	11,867	12,729	9.6	6.6
Total	26,622	28,660	30,003	31,656	33,714	6.2	6.0

Greece	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large	12	14	15	16	17	11.8	7.7
Medium	20	22	25	28	32	10.7	14.5
Small	29	33	37	42	48	12.3	14.4
Workstation	4	9	11	13	16	63.6	20.4
PCs - professional market	82	90	106	127	155	13.5	21.0
PC printers	30	33	39	47	57	14.5	20.7
Computer hardware	177	200	232	273	325	14.4	18.4
Typewriters	11	11	12	12	12	3.2	0.0
Calculators	7	7	8	8	9	4.7	7.2
Copiers	49	52	53	53	54	3.7	1.4
Other Office Equipment	34	36	37	38	38	3.7	1.8
Office equipment	101	106	109	111	113	3.7	1.8
LAN hardware	6	7	9	12	16	23.2	33.0
Other data communications	1	1	1	2	3	18.3	33.6
Data communications hardware	7	8	11	14	19	22.5	33.1
Systems/utilities	12	14	17	22	28	19.7	26.7
Application tools	3	3	3	3	4	- 1.7	18.9
Application solutions	28	31	38	47	59	15.9	25.6
Software products	43	48	58	72	91	15.8	25.6
Professional services	8	10	12	15	20	21.4	29.2
Hardware maintenance & support services	20	24	30	38	49	22.9	27.6
Other services	20	24	30	38	49	22.9	27.6
Total	356	396	451	524	616	12.5	16.9

Table 12
Greece
IT Market Value
(ECU Millions)

Table 13
Ireland
IT Market Value
(ECU Millions)

Ireland	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large	29	31	32	34	36	5.4	4.9
Medium	58	62	65	68	71	5.4	4.9
Small	87	92	97	102	107	5.4	4.9
Workstations	7	8	9	10	11	13.4	10.6
PCs	63	59	55	52	51	- 6.6	- 3.7
PC printers	17	17	18	19	20	4.6	4.8
Computer hardware	262	269	277	285	296	2.8	3.4
Typewriters	13	13	13	11	10	- 1.3	- 10.7
Calculators	10	10	10	11	11	1.9	4.1
Copiers	62	62	64	66	63	1.6	- 0.3
Other Office Equipment	43	43	44	45	43	1.2	- 1.2
Office equipment	127	127	130	133	127	1.2	- 1.2
Systems/utilities	19	20	23	26	29	10.3	13.4
Application tools	16	19	23	27	31	18.3	16.5
Application solutions	23	28	32	38	45	17.4	17.3
Software products	58	67	78	91	104	15.5	15.9
Professional services	36	42	49	58	68	16.4	17.3
Processing services	24	26	28	30	32	6.5	7.1
Network services	3	4	5	6	6	22.5	15.5
Hardware maintenance & support services	44	48	54	61	68	11.4	12.0
Other services	71	78	87	96	106	10.3	10.6
All services	108	120	136	155	174	12.4	13.1
Total	555	583	621	664	701	5.8	6.3

Table 14
Italy
IT Market Value
(ECU Millions)

Italy	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large	745	688	614	583	580	- 9.3	- 2.8
Medium	819	810	755	692	690	- 4.0	- 4.4
Small	881	855	873	877	870	- 0.5	- 0.2
Workstation	118	154	161	161	225	16.7	18.2
PCs - professional market	1,634	1,502	1,469	1,441	1,636	- 5.2	5.5
PCs - home market	196	181	184	126	143	- 3.1	- 11.7
PC printers	457	493	514	536	568	6.0	5.2
Computer hardware	4,850	4,683	4,569	4,417	4,713	- 2.9	1.6
Typewriters	130	130	101	91	81	- 11.9	- 10.7
Calculators	101	101	108	119	113	3.4	2.1
Copiers	610	610	644	657	632	2.7	- 0.9
Other Office Equipment	429	429	435	442	421	0.7	- 1.6
Office equipment	1,271	1,271	1,288	1,309	1,246	0.7	- 1.6
LAN hardware	39	56	64	69	73	28.3	6.8
Other data communications	196	203	213	219	226	4.1	3.1
Data communications hardware	235	258	277	288	299	8.5	4.0
Systems/utilities	626	697	744	780	859	9.0	7.5
Application tools	744	842	918	1,015	1,090	11.1	8.9
Application solutions	757	868	973	1,085	1,170	13.4	9.7
Software products	2,126	2,407	2,635	2,881	3,119	11.3	8.8
IT consulting	222	258	296	324	340	15.4	7.2
Contract programming	1,186	1,396	1,523	1,766	1,824	13.3	9.4
Staff delegation	290	326	347	338	367	9.4	2.8
Education & training	554	678	809	934	978	20.8	10.0
Systems & network operation	203	242	280	297	359	17.6	13.2
Professional services	2,454	2,899	3,254	3,659	3,868	15.2	9.0
Processing services	711	750	789	791	811	5.3	1.4
Network services	254	313	385	436	533	23.0	17.7
Hardware maintenance & support services	1,126	1,187	1,210	1,226	1,254	3.7	1.8
Other services	2,091	2,250	2,384	2,453	2,597	6.8	4.4
All services	4,546	5,149	5,638	6,112	6,465	11.4	7.1
Total	13,028	13,767	14,406	15,007	15,842	5.2	4.9

Table 15
Netherlands
IT Market Value
(ECU Millions)

Netherlands	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large	314	314	271	260	255	- 7.2	- 2.9
Medium	411	401	343	367	394	- 8.7	7.2
Small	249	234	238	234	239	- 2.1	0.2
Workstation	72	92	97	105	119	15.8	10.6
PCs - professional market	1,021	989	972	971	1,081	- 2.4	5.5
PCs - home market	97	96	81	93	106	- 8.7	14.5
PC printers	264	285	295	302	308	5.7	2.2
Computer hardware	2,429	2,411	2,297	2,333	2,502	- 2.8	4.4
Typewriters	77	76	73	64	52	- 2.9	- 15.5
Calculators	55	56	58	56	61	2.3	2.7
Copiers	432	425	418	444	461	- 1.6	5.0
Other Office Equipment	288	284	280	287	293	- 1.4	2.3
Office equipment	852	842	829	850	867	- 1.4	2.3
LAN hardware	41	47	52	53	53	13.8	1.0
Other data communications	63	66	69	68	70	4.4	0.7
Data communications hardware	104	112	121	121	123	8.1	0.8
Systems/utilities	253	266	285	305	332	6.2	7.9
Application tools	258	296	347	413	505	16.1	20.5
Application solutions	366	425	487	555	646	15.3	15.2
Software products	876	988	1,119	1,273	1,482	13.0	15.1
IT consulting	239	264	292	319	358	10.5	10.8
Contract programming	556	612	676	747	833	10.3	11.0
Staff delegation	171	183	196	208	227	7.1	7.6
Education & training	226	260	299	340	403	15.0	16.1
Systems & network operation	111	128	147	165	204	14.9	18.0
Professional services	1,302	1,447	1,609	1,780	2,024	11.1	12.2
Processing services	576	588	612	635	662	3.0	4.0
Network services	55	58	62	63	69	6.4	5.1
Hardware maintenance & support services	478	507	559	528	671	8.1	9.5
Other services	1,109	1,153	1,233	1,226	1,401	5.4	6.6
All services	2,411	2,600	2,841	3,006	3,425	8.6	9.8
Total	6,673	6,954	7,208	7,583	8,399	3.9	8.0

Norway	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large	90	69	68	67	67	- 13.3	- 0.2
Medium	86	82	73	73	75	- 7.6	0.9
Small	83	83	85	88	92	1.4	4.2
Workstation	31	41	43	46	50	17.0	8.1
PCs - professional market	404	486	361	332	321	- 5.5	- 5.8
PCs - home market	27	19	23	25	27	- 7.9	8.6
PC printers	76	82	90	101	111	8.9	11.1
Computer hardware	796	862	743	733	743	- 3.4	0.0
Typewriters	30	30	26	25	22	- 5.6	- 9.1
Calculators	20	21	20	19	19	- 1.5	- 1.8
Copiers	147	156	166	161	161	6.1	- 1.5
Other Office Equipment	101	105	108	105	103	3.6	- 2.5
Office equipment	298	312	320	311	304	3.6	- 2.5
LAN hardware	17	21	24	26	26	19.4	4.5
Other data communications	23	25	26	27	27	6.5	2.5
Data communications hardware	40	46	50	53	53	12.2	3.4
Systems/utilities	55	62	67	72	79	10.2	8.6
Application tools	90	102	108	115	125	9.8	7.4
Application solutions	134	150	164	177	190	10.3	7.8
Software products	279	314	339	363	394	10.1	7.8
IT consulting	75	79	84	89	94	5.3	6.1
Contract programming	147	151	155	161	164	2.8	2.9
Staff delegation	62	62	62	63	63	0.3	1.0
Education & training	66	67	69	71	73	2.7	2.6
Systems & network operation	17	21	25	30	35	21.0	19.2
Professional services	366	381	395	414	429	3.8	4.3
Processing services	331	352	379	424	476	7.0	12.0
Network services	39	45	51	58	66	14.5	13.4
Hardware maintenance & support services	297	291	288	284	282	- 1.6	- 1.0
Other services	667	688	718	766	823	3.7	7.1
All services	1,034	1,069	1,112	1,180	1,252	3.7	6.1
Total	2,447	2,602	2,564	2,640	2,747	2.4	3.5

Table 16
Norway
IT Market Value
(ECU Millions)

Table 17
Portugal
IT Market Value
(ECU Millions)

Portugal	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large	100	120	143	168	209	19.8	20.9
Medium	53	65	77	93	116	20.0	22.7
Small	66	81	97	116	144	20.8	21.8
Workstations	9	11	14	18	24	24.7	30.9
PCs	80	98	116	139	176	20.4	23.2
PC printers	18	22	26	32	40	21.6	23.4
Computer hardware	326	397	473	566	709	20.4	22.4
Typewriters	11	11	11	12	12	1.5	2.5
Calculators	7	7	8	8	9	4.7	7.2
Copiers	48	51	52	52	53	3.7	1.4
Other Office Equipment	34	35	36	37	38	3.5	2.2
Office equipment	100	104	107	109	111	3.5	2.2
Software products	66	86	110	139	181	28.7	28.3
Professional services	57	73	91	113	148	26.3	27.4
Processing & network services	11	15	18	23	30	26.3	27.4
Hardware maintenance & support services	70	86	102	122	152	20.3	22.2
Other services	82	100	120	144	182	21.2	23.0
Total	631	761	901	1,071	1,331	19.5	21.5

Table 18
Spain
IT Market Value
(ECU Millions)

Spain	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large	503	450	478	467	473	- 2.5	- 0.6
Medium	320	330	346	358	374	4.0	4.0
Small	356	456	481	520	561	16.2	8.0
Workstation	54	70	101	150	214	36.2	46.0
PCs - professional market	1,107	1,238	1,123	1,053	1,110	0.7	- 0.6
PCs - home market	177	212	231	254	286	14.1	11.3
PC printers	302	326	371	416	469	10.9	12.4
Computer hardware	2,820	3,083	3,130	3,219	3,487	5.4	5.5
Typewriters	93	89	84	75	63	- 4.5	- 13.7
Calculators	60	62	66	72	75	4.7	7.2
Copiers	416	439	448	451	460	3.7	1.4
Other Office Equipment	290	301	305	305	305	2.5	0.1
Office equipment	858	892	903	902	904	2.5	0.1
LAN hardware	33	43	48	53	54	20.8	5.4
Other data communications	90	104	111	118	123	11.2	5.3
Data communications hardware	123	147	160	171	177	13.9	5.3
Systems/utilities	224	248	266	284	298	8.9	5.9
Application tools	168	206	240	270	305	19.3	12.8
Application solutions	254	306	360	419	487	19.1	16.3
Software products	646	760	866	973	1,090	15.7	12.2
IT consulting	116	133	156	180	208	16.0	15.5
Contract programming	267	294	338	392	465	12.4	17.3
Staff delegation	76	88	101	118	136	15.0	16.2
Education & training	104	130	156	195	242	22.2	24.4
Systems & network operation	26	28	31	35	40	9.0	13.6
Professional services	590	673	781	919	1,090	15.1	18.1
Processing services	147	157	165	171	178	5.7	3.9
Network services	16	24	28	32	36	32.3	13.4
Hardware maintenance & support services	601	626	666	704	757	5.3	6.6
Other services	765	807	859	908	971	6.0	6.3
All services	1,354	1,480	1,640	1,827	2,061	10.0	12.1
Total	5,802	6,362	6,698	7,093	7,719	7.4	7.4

Table 19
Sweden
IT Market Value
(ECU Millions)

Sweden	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large	303	247	227	212	215	- 13.4	- 2.7
Medium	183	185	169	170	173	- 3.9	1.3
Small	182	163	154	162	165	- 8.1	3.7
Workstation	78	95	97	121	153	11.4	25.3
PCs - professional market	820	806	679	634	650	- 9.0	- 2.2
PCs - home market	69	36	48	56	61	- 16.7	12.7
PC printers	149	161	178	195	205	9.3	7.4
Computer hardware	1,784	1,694	1,552	1,550	1,622	- 6.7	2.2
Typewriters	32	45	40	35	30	12.7	- 13.9
Calculators	34	34	35	40	38	2.0	4.0
Copiers	250	255	261	265	278	2.2	3.2
Other Office Equipment	161	170	171	173	176	3.3	1.4
Office equipment	475	503	507	513	522	3.3	1.4
LAN hardware	36	47	42	49	50	8.5	8.2
Other data communications	57	63	54	58	60	- 2.3	4.7
Data communications hardware	93	111	97	106	109	2.0	6.2
Systems/utilities	120	130	131	141	146	4.5	5.5
Application tools	186	202	207	219	230	5.5	5.4
Application solutions	293	316	334	360	375	6.7	6.0
Software products	599	648	672	721	751	5.9	5.7
IT consulting	167	178	177	185	190	2.8	3.7
Contract programming	273	292	294	322	330	3.8	5.9
Staff delegation	609	634	635	669	705	2.1	5.4
Education & training	118	125	114	117	122	- 1.6	3.1
Systems & network operation	55	67	69	87	108	11.9	25.1
Professional services	1,222	1,296	1,289	1,381	1,454	2.7	6.2
Processing services	521	541	552	607	670	2.9	10.2
Network services	52	56	49	67	77	- 3.2	26.0
Hardware maintenance & support services	698	706	699	704	710	0.1	0.8
Other services	1,271	1,304	1,299	1,377	1,457	1.1	5.9
All services	2,493	2,600	2,588	2,758	2,911	1.9	6.1
Total	5,445	5,555	5,416	5,648	5,915	- 0.3	4,5

Table 20
Switzerland
IT Market Value
(ECU Millions)

Switzerland	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large	443	388	392	383	398	- 5.9	0.8
Medium	258	232	225	217	220	- 6.6	- 1.1
Small	297	214	220	223	235	- 14.0	3.4
Workstation	110	117	128	145	171	7.7	15.8
PCs - professional market	966	948	735	738	823	- 12.8	5.8
PCs - home market	113	130	134	135	155	8.6	7.6
PC printers	253	273	300	325	350	8.9	8.1
Computer hardware	2,440	2,301	2,133	2,166	2,351	- 6.5	5.0
Typewriters	50	49	42	39	36	- 8.1	- 7.5
Calculators	40	37	37	37	37	- 4.4	0.7
Copiers	208	217	228	230	252	4.7	5.2
Other Office Equipment	152	154	156	156	166	1.5	3.0
Office equipment	450	457	463	463	491	1.5	3.0
LAN hardware	26	35	38	32	32	20.8	- 7.9
Other data communications	45	51	53	46	48	9.0	- 4.6
Data communications hardware	70	86	91	78	80	13.5	- 6.0
Systems/utilities	233	247	267	291	315	7.0	8.7
Application tools	217	239	262	295	342	9.9	14.2
Application solutions	382	428	479	548	640	12.0	15.5
Software products	833	914	1,009	1,134	1,297	10.1	13.4
IT consulting	380	391	418	474	516	4.9	11.2
Contract programming	174	210	254	250	253	20.8	- 0.3
Staff delegation	102	132	167	173	188	27.8	6.3
Education & training	79	98	134	146	170	29.8	12.6
Systems & network operation	50	52	56	61	76	5.9	16.1
Professional services	786	883	1,029	1,104	1,203	14.4	8.1
Processing services	277	281	288	289	300	2.0	2.1
Network services	122	130	140	151	171	6.9	10.5
Hardware maintenance & support services	522	457	552	564	582	2.8	2.6
Other services	922	868	980	1,004	1,052	3.1	3.6
All services	1,707	1,751	2,009	2,108	2,255	8.5	6.0
Total	5,501	5,509	5,704	5,949	6,475	1.8	6.5

Table 21
UK
IT Market Value
(ECU Millions)

UK	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large	1,181	1,014	923	862	880	- 11.6	- 2.4
Medium	1,304	1,157	1,040	908	910	- 10.7	- 6.4
Small	1,042	844	831	740	747	- 10.7	- 5.2
Workstation	341	405	443	474	502	14.0	6.6
PCs - professional market	3,031	2,839	2,348	2,491	2,910	- 12.0	11.3
PCs - home market	275	337	303	315	378	5.0	11.7
PC printers	647	744	802	850	890	11.3	5.4
Computer hardware	**7,820**	**7,341**	**6,690**	**6,640**	**7,218**	**- 7.5**	**3.9**
Typewriters	223	216	187	184	158	- 8.5	- 8.1
Calculators	164	165	167	181	179	0.9	3.4
Copiers	1,056	1,071	1,091	1,122	1,132	1.7	1.8
Other Office Equipment	736	740	737	759	749	0.1	0.8
Office equipment	**2,179**	**2,191**	**2,182**	**2,246**	**2,217**	**0.1**	**0.8**
LAN hardware	157	192	209	219	219	15.3	2.4
Other data communications	316	330	345	357	365	4.5	2.9
Data communications hardware	**473**	**522**	**554**	**576**	**584**	**8.2**	**2.7**
Systems/utilities	948	957	1,016	1,058	1,111	3.6	4.5
Application tools	855	951	1,075	1,147	1,197	12.2	5.5
Application solutions	1,141	1,250	1,410	1,508	1,608	11.1	6.8
Software products	**2,944**	**3,158**	**3,501**	**3,713**	**3,916**	**9.1**	**5.8**
IT consulting	535	594	682	749	820	12.9	9.7
Contract programming	1,147	1,244	1,399	1,484	1,617	10.4	7.5
Staff delegation	294	300	327	345	361	5.4	5.1
Education & training	478	475	486	497	519	0.8	3.4
Systems & network operation	445	507	621	734	824	18.2	15.2
Professional services	2,898	3,119	3,514	3,810	4,141	10.1	8.6
Processing services	1,057	1,114	1,174	1,233	1,281	5.4	4.5
Network services	172	211	269	327	380	25.2	18.7
Hardware maintenance & support services	2,158	2,228	2,246	2,178	2,190	2.0	- 1.3
Other services	3,387	3,553	3,689	3,739	3,851	4.4	2.2
All services	**6,285**	**6,673**	**7,203**	**7,548**	**7,991**	**7.1**	**5.3**
Total	19,701	19,885	20,130	20,723	21,926	1.1	4.4

Eastern Europe	1991	1992	1993	1994		CAGR 92-94 %
Large	78	34	66	104		74.6
Medium	98	41	49	65		25.6
Small	147	63	72	85		16.2
Workstations	14	22	29	42		37.8
PCs - professional market	651	522	680	871		29.2
PCs - home market	18	11	9	10		- 7.4
PC printers	217	244	305	360		21.6
Computer hardware	1,223	937	1,210	1,537		28.1
Typewriters	N/A	N/A	N/A	N/A		N/A
Calculators	N/A	N/A	N/A	N/A		N/A
Copiers	129	142	166	188		15.0
Other Office Equipment	57	57	72	87		24.1
Office equipment	187	199	238	275		17.7
LAN hardware	22	28	38	65		51.2
Data communications hardware	22	28	38	65		51.2
Software products	484	490	544	665		16.5
Professional services	355	349	432	560		26.6
Other services	394	449	504	576		13.3
Total	2,664	2,453	2,966	3,678		22.5

Table 22
Eastern Europe
IT Market Value
(ECU Millions)

Former Czechoslovakia	1991	1992	1993	1994		CAGR 92-94 %
Large	11	12	19	27		48.3
Medium	7	13	14	18		17.3
Small	26	23	26	29		11.4
Workstations	4	7	10	14		37.4
PCs - professional market	89	93	102	115		11.1
PCs - home market	2	2	1	1		- 29.3
PC printers	49	58	68	80		17.3
Computer hardware	190	209	239	284		16.5
Typewriters	N/A	N/A	N/A	N/A		N/A
Calculators	N/A	N/A	N/A	N/A		N/A
Copiers	35	37	39	45		10.3
Other Office Equipment	13	12	12	14		6.7
Office equipment	48	49	51	59		9.4
LAN hardware	5	6	6	8		19.5
Data communications hardware	5	6	6	8		19.5
Software products	57	70	83	96		17.1
Professional services	47	58	74	85		20.8
Other services	49	61	72	83		16.6
Total	395	452	525	613		16.5

Table 23
Former
Czechoslovakia
IT Market Value
(ECU Millions)

Table 24
Hungary
IT Market Value
(ECU Millions)

Hungary	1991	1992	1993	1994		CAGR 92-94 %
Large	5	5	7	13		63.3
Medium	14	12	14	15		12.5
Small	11	12	10	11		- 2.8
Workstations	2	6	6	9		25.4
PCs - professional market	138	113	120	146		13.4
PCs - home market	2	2	1	1		- 29.3
PC printers	46	58	69	79		16.7
Computer hardware	219	208	227	275		14.9
Typewriters	N/A	N/A	N/A	N/A		N/A
Calculators	N/A	N/A	N/A	N/A		N/A
Copiers	24	29	31	34		8.0
Other Office Equipment	10	9	11	12		16.8
Office equipment	34	38	41	46		10.1
LAN hardware	4	5	6	7		22.5
Data communications hardware	4	5	6	7		22.5
Systems/utilities	8	10	11	12		11.8
Application tools	23	27	32	37		18.1
Application solutions	25	32	39	46		20.9
Software products	56	68	82	96		18.5
Professional services	57	68	78	87		13.4
Other services	53	60	69	76		12.7
Total	423	447	502	587		14.6

Table 25
Poland
IT Market Value
(ECU Millions)

Poland	1991	1992	1993	1994		CAGR 92-94 %
Large	8	11	15	25		54.4
Medium	3	6	8	12		48.9
Small	18	17	18	20		9.4
Workstations	2	3	4	7		55.3
PCs - professional market	99	109	143	177		27.5
PCs - home market	9	5	3	2		- 29.3
PC printers	53	70	87	100		19.4
Computer hardware	192	220	277	344		25.1
Typewriters	N/A	N/A	N/A	N/A		N/A
Calculators	N/A	N/A	N/A	N/A		N/A
Copiers	21	24	26	30		12.6
Other Office Equipment	10	11	13	14		12.2
Office equipment	31	35	40	44		12.5
LAN hardware	7	9	11	13		20.6
Data communications hardware	7	9	11	13		20.6
Software products	28	36	47	53		20.2
Professional services	52	61	70	79		14.3
Other services	48	53	63	69		14.4
Total	358	414	507	602		20.7

Former Soviet Union	1991	1992	1993	1994		CAGR 92-94 %
Large	53	6	26	39		144.9
Medium	74	11	13	19		35.9
Small	92	11	19	24		51.9
Workstations	6	7	9	13		40.6
PCs - professional market	325	207	316	433		44.8
PCs - home market	4	3	4	6		32.3
PC printers	69	57	81	100		33.1
Computer hardware	622	301	467	635		45.3
Typewriters	N/A	N/A	N/A	N/A		N/A
Calculators	N/A	N/A	N/A	N/A		N/A
Copiers	49	53	70	79		22.8
Other Office Equipment	25	24	36	47		39.0
Office equipment	75	77	106	126		28.1
LAN hardware	6	9	15	36		102.3
Data communications hardware	6	9	15	36		102.3
Software products	343	316	332	421		15.5
Professional services	199	162	211	308		37.8
Other services	244	275	300	348		12.5
Total	1,488	1,140	1,431	1,875		28.3

Table 26
Former Soviet Union
IT Market Value
(ECU Millions)

Table 27
EC
IT Market
(Units Shipped)

EC	1990	1991	1992	1993	1994	CAGR 90–92 %	CAGR 92–94 %
Large scale systems	1,163	1,116	1,064	1,082	1,118	- 4.4	2.5
Medium scale systems	17,020	14,706	15,100	16,070	17,150	- 5.8	6.6
Small scale systems	133,047	137,745	149,230	159,840	168,230	5.9	6.2
Workstations	81,551	113,981	153,312	219,197	296,454	37.1	39.1
PCs - professional market	4,874,000	5,266,000	5,618,000	6,026,000	6,453,000	7.4	7.2
PCs - home market	2,031,000	2,421,000	2,543,000	2,722,000	2,888,000	11.9	6.6
PC printers	6,244,601	6,483,526	7,295,731	7,983,510	8,636,251	8.1	8.8
Typewriters	2,427,620	2,415,583	2,283,736	2,189,880	1,986,102	- 3.0	- 6.7
Calculators	20,613,650	21,329,160	22,083,482	22,845,798	23,249,408	3.5	2.6
Copiers	1,554,580	1,592,429	1,664,280	1,727,182	1,772,075	3.5	3.2
LAN hardware	1,661,300	2,186,500	2,695,100	3,099,900	3,312,100	27.4	10.9

Table 28
EFTA
IT Market
(Units Shipped)

EFTA	1990	1991	1992	1993	1994	CAGR 90–92 %	CAGR 92–94 %
Large scale systems	190	152	159	167	177	- 8.5	5.5
Medium scale systems	2,675	1,914	2,085	2,340	2,480	- 11.7	9.1
Small scale systems	21,510	18,755	20,500	22,190	23,400	- 2.4	6.8
Workstations	16,825	22,781	30,738	41,428	52,774	35.2	31.0
PCs - professional market	809,000	882,000	930,000	991,000	1,079,000	7.2	7.7
PCs - home market	247,000	258,000	273,000	299,000	340,000	5.1	11.6
PC printers	840,992	890,187	1,058,280	1,214,887	1,377,955	12.2	14.1
Typewriters	341,000	361,589	319,128	293,072	255,007	- 3.3	- 10.6
Calculators	3,186,080	3,162,138	3,226,360	3,357,152	3,345,699	0.6	1.8
Copiers	259,500	267,611	277,923	280,080	292,731	3.5	2.6
LAN hardware	348,400	460,400	552,200	634,400	686,000	25.9	11.5

Table 29
EC + EFTA
IT Market
(Units Shipped)

EC + EFTA	1990	1991	1992	1993	1994	CAGR 90–92 %	CAGR 92–94 %
Large scale systems	1,353	1,268	1,223	1,249	1,295	- 4.9	2.9
Medium scale systems	19,695	16,620	17,185	18,410	19,630	- 6.6	6.9
Small scale systems	154,557	156,500	169,730	182,030	191,630	4.8	6.3
Workstations	98,376	136,762	184,050	260,625	349,228	36.8	37.7
PCs - professional market	5,683,000	6,148,000	6,548,000	7,017,000	7,532,000	7.3	7.3
PCs - home market	2,278,000	2,679,000	2,816,000	3,021,000	3,228,000	11.2	7.1
PC printers	7,085,594	7,373,713	8,354,011	9,198,397	10,014,206	8.6	9.5
Typewriters	2,768,620	2,777,172	2,602,864	2,482,953	2,241,109	- 3.0	- 7.2
Calculators	23,799,730	24,491,298	25,309,842	26,202,950	26,595,107	3.1	2.5
Copiers	1,814,080	1,860,039	1,942,202	2,007,262	2,064,806	3.5	3.1
LAN hardware	2,009,700	2,646,900	3,247,300	3,734,300	3,998,100	27.1	11.0

Austria	1990	1991	1992	1993	1994	CAGR 90–92 %	CAGR 92–94 %
Large scale systems	33	21	23	24	25	- 16.5	4.3
Medium scale systems	646	379	420	480	515	- 19.4	10.7
Small scale systems	4,800	4,635	5,050	5,460	5,760	2.6	6.8
Workstations	2,285	3,173	4,568	6,928	9,843	41.4	46.8
PCs - professional market	96,000	110,000	122,000	137,000	151,000	12.7	11.3
PCs - home market	42,000	46,000	48,000	56,000	63,000	6.9	14.6
PC printers	168,827	176,330	197,587	215,548	231,872	8.2	8.3
Typewriters	50,000	48,662	45,042	43,331	36,297	- 5.1	- 10.2
Calculators	420,000	440,029	501,996	518,557	552,758	9.3	4.9
Copiers	33,500	32,880	31,135	31,922	31,936	- 3.6	1.3
LAN hardware	31,700	42,700	52,000	58,400	63,500	28.1	10.5

Table 30
Austria
IT Market
(Units Shipped)

Belgium/Luxembourg	1990	1991	1992	1993	1994	CAGR 90–92 %	CAGR 92–94 %
Large scale systems	39	42	44	45	47	6.2	3.4
Medium scale systems	498	528	550	610	650	5.1	8.7
Small scale systems	5,021	5,051	5,510	5,950	6,250	4.8	6.5
Workstations	2,374	3,240	5,087	7,734	10,747	46.4	45.3
PCs - professional market	170,000	178,000	195,000	199,000	207,000	7.1	3.0
PCs - home market	62,000	62,000	63,000	66,000	70,000	0.8	5.4
PC printers	272,155	283,151	317,288	343,707	366,869	8.0	7.5
Typewriters	85,000	80,106	69,411	55,243	52,200	- 9.6	- 13.3
Calculators	700,000	694,350	643,879	655,200	683,105	- 4.1	3.0
Copiers	50,000	52,583	55,485	59,777	61,091	5.3	4.9
LAN hardware	56,900	75,200	88,400	98,600	99,300	24.6	6.0

Table 31
Belgium/Luxembourg
IT Market
(Units Shipped)

Denmark	1990	1991	1992	1993	1994	CAGR 90–92 %	CAGR 92–94 %
Large scale systems	54	37	37	38	40	- 17.2	4.0
Medium scale systems	365	361	390	430	460	3.4	8.6
Small scale systems	2,582	2,731	3,000	3,240	3,430	7.8	6.9
Workstations	1,453	2,014	2,397	3,291	4,610	28.4	38.7
PCs - professional market	142,000	153,000	169,000	180,000	178,000	9.1	2.6
PCs - home market	35,000	41,000	50,000	54,000	57,000	19.5	6.8
PC printers	151,905	160,775	179,913	200,422	221,021	8.8	10.8
Typewriters	68,000	62,638	53,288	52,037	46,136	- 11.5	- 7.0
Calculators	545,000	551,836	529,356	547,879	538,896	- 1.4	0.9
Copiers	42,000	45,215	50,642	55,264	63,123	9.8	11.6
LAN hardware	69,600	92,400	111,200	125,300	130,400	26.4	8.3

Table 32
Denmark
IT Market
(Units Shipped)

Table 33
Finland
IT Market
(Units Shipped)

Finland	1990	1991	1992	1993	1994	CAGR 90–92 %	CAGR 92–94 %
Large scale systems	27	19	19	20	21	- 16.1	5.1
Medium scale systems	194	167	180	200	210	- 3.7	8.0
Small scale systems	2,521	2,492	2,720	2,940	3,100	3.9	6.8
Workstations	1,644	2,242	2,765	3,572	4,545	29.7	28.2
PCs - professional market	142,000	130,000	127,000	130,000	170,000	- 5.4	15.7
PCs - home market	24,000	16,000	15,000	17,000	27,000	- 20.9	34.2
PC printers	107,583	107,583	130,749	158,019	193,458	10.2	21.6
Typewriters	52,000	49,061	40,226	35,253	30,177	- 12.0	- 13.4
Calculators	420,000	432,187	443,903	437,016	445,624	2.8	0.2
Copiers	37,000	38,448	42,305	42,965	45,017	6.9	3.2
LAN hardware	60,000	81,900	103,500	117,000	123,900	31.3	9.4

Table 34
France
IT Market
(Units Shipped)

France	1990	1991	1992	1993	1994	CAGR 90–92 %	CAGR 92–94 %
Large scale systems	190	182	180	185	190	- 2.7	2.7
Medium scale systems	3,277	2,750	2,900	3,050	3,250	- 5.9	5.9
Small scale systems	27,214	27,900	28,500	29,000	30,500	2.3	3.4
Workstations	16,576	22,990	30,143	42,019	56,154	34.9	36.5
PCs - professional market	930,000	992,000	1,043,000	1,120,000	1,181,000	5.9	6.4
PCs - home market	283,000	326,000	349,000	398,000	438,000	11.1	12.0
PC printers	983,250	1,049,840	1,191,916	1,318,805	1,452,661	10.1	10.4
Typewriters	400,000	397,863	343,335	316,790	269,671	- 7.4	- 11.4
Calculators	3,600,000	3,877,853	3,946,250	3,807,985	4,149,295	4.7	2.5
Copiers	295,000	305,563	318,187	336,811	367,183	3.9	7.4
LAN hardware	339,300	426,800	496,500	575,600	624,700	21.0	12.2

Table 35
Germany
IT Market
(Units Shipped)

Germany	1990	1991	1992	1993	1994	CAGR 90–92 %	CAGR 92–94 %
Large scale systems	400	392	341	335	352	- 7.7	1.6
Medium scale systems	4,191	4,240	4,040	4,080	4,210	- 1.8	2.1
Small scale systems	30,734	33,400	37,870	42,850	45,560	11.0	9.7
Workstations	25,753	37,525	51,057	73,697	97,781	40.8	38.4
PCs - professional market	1,196,000	1,278,000	1,383,000	1,497,000	1,623,000	7.5	8.3
PCs - home market	812,000	1,118,000	1,193,000	1,274,000	1,316,000	21.2	5.0
PC printers	2,061,667	2,184,198	2,482,789	2,699,232	2,852,852	9.7	7.2
Typewriters	750,000	775,590	805,808	827,285	814,833	3.7	0.6
Calculators	6,400,000	6,727,397	7,220,986	7,380,117	7,315,650	6.2	0.7
Copiers	380,000	391,822	429,665	439,677	441,822	6.3	1.4
LAN hardware	407,600	548,900	704,400	819,000	859,400	31.5	10.5

Italy	1990	1991	1992	1993	1994	CAGR 90–92 %	CAGR 92–94 %
Large scale systems	143	142	135	145	148	- 2.8	4.7
Medium scale systems	3,546	2,600	2,700	2,900	3,150	- 12.7	8.0
Small scale systems	20,999	22,900	25,000	27,000	28,000	9.1	5.8
Workstations	6,629	9,595	12,203	16,725	23,095	35.7	37.6
PCs - professional market	563,000	639,000	681,000	750,000	824,000	10.0	10.0
PCs - home market	237,000	228,000	228,000	226,000	231,000	- 1.9	0.7
PC printers	705,365	719,496	764,438	817,680	885,811	4.1	7.6
Typewriters	279,620	279,620	272,300	244,526	217,092	- 1.3	- 10.7
Calculators	2,388,650	2,388,650	2,478,500	2,738,743	2,683,968	1.9	4.1
Copiers	192,580	192,580	198,650	205,296	197,450	1.6	- 0.3
LAN hardware	124,600	170,600	215,000	251,800	276,200	31.4	13.3

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Table 36
Italy
IT Market
(Units Shipped)

Netherlands	1990	1991	1992	1993	1994	CAGR 90–92 %	CAGR 92–94 %
Large scale systems	51	67	65	65	65	12.9	0.0
Medium scale systems	1,082	930	1,000	1,200	1,340	- 3.9	15.8
Small scale systems	7,358	6,500	7,000	7,250	7,540	- 2.5	3.8
Workstations	5,679	6,992	8,956	11,128	13,047	25.6	20.7
PCs - professional market	395,000	417,000	445,000	459,000	483,000	6.1	4.2
PCs - home market	100,000	103,000	99,000	103,000	107,000	- 0.5	4.0
PC printers	420,077	431,568	472,138	505,991	529,031	6.0	5.9
Typewriters	166,000	164,089	156,516	136,892	111,671	- 2.9	- 15.5
Calculators	1,380,000	1,403,727	1,444,918	1,393,495	1,523,290	2.3	2.7
Copiers	135,000	132,885	130,702	138,691	144,058	- 1.6	5.0
LAN hardware	108,000	144,000	175,200	199,100	212,900	27.4	10.2

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Table 37
Netherlands
IT Market
(Units Shipped)

Norway	1990	1991	1992	1993	1994	CAGR 90–92 %	CAGR 92–94 %
Large scale systems	27	20	21	22	23	- 11.8	4.7
Medium scale systems	412	202	225	250	265	- 26.1	8.5
Small scale systems	2,205	2,402	2,620	2,830	2,980	9.0	6.6
Workstations	1,942	2,812	3,633	4,331	4,908	36.8	16.2
PCs - professional market	133,000	168,000	180,000	188,000	193,000	16.3	3.5
PCs - home market	24,000	24,000	27,000	28,000	29,000	6.1	3.6
PC printers	105,077	112,082	130,336	149,940	171,442	11.4	14.7
Typewriters	64,000	63,480	56,981	54,309	47,111	- 5.6	- 9.1
Calculators	505,000	512,807	489,763	478,367	472,284	- 1.5	- 1.8
Copiers	46,000	48,876	51,758	50,456	50,193	6.1	- 1.5
LAN hardware	47,400	63,500	80,000	93,400	101,800	29.9	12.8

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Table 38
Norway
IT Market
(Units Shipped)

Table 39
Spain
IT Market
(Units Shipped)

Spain	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large scale systems	67	63	72	74	78	3.7	4.1
Medium scale systems	946	777	870	1,000	1,090	- 4.1	11.9
Small scale systems	10,425	13,163	14,850	16,550	17,950	19.4	9.9
Workstations	2,531	4,028	7,003	11,653	17,368	66.3	57.5
PCs - professional market	394,000	427,000	451,000	470,000	500,000	7.0	5.3
PCs - home market	170,000	181,000	197,000	214,000	237,000	7.6	9.7
PC printers	524,517	529,938	596,008	673,076	772,283	6.6	13.8
Typewriters	199,000	192,103	181,519	161,456	135,326	- 4.5	- 13.7
Calculators	1,500,000	1,559,780	1,643,041	1,789,734	1,887,084	4.7	7.2
Copiers	130,000	137,199	139,872	140,921	143,740	3.7	1.4
LAN hardware	124,100	163,800	198,800	230,800	247,500	26.6	11.6

Table 40
Sweden
IT Market
(Units Shipped)

Sweden	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large scale systems	50	41	41	42	45	- 9.4	4.8
Medium scale systems	584	544	590	660	700	0.5	8.9
Small scale systems	3,824	4,100	4,470	4,830	5,090	8.1	6.7
Workstations	4,722	7,002	9,721	13,181	17,023	43.5	32.3
PCs - professional market	229,000	248,000	263,000	278,000	288,000	7.2	4.6
PCs - home market	54,000	54,000	59,000	63,000	66,000	4.5	5.8
PC printers	200,271	204,673	247,395	286,497	324,642	11.1	14.6
Typewriters	68,000	95,879	86,424	75,344	64,084	12.7	- 13.9
Calculators	841,080	841,080	875,861	1,002,261	947,046	2.0	4.0
Copiers	78,000	79,642	81,496	82,774	86,787	2.2	3.2
LAN hardware	118,700	154,000	184,400	216,600	235,800	24.6	13.1

Table 41
Switzerland
IT Market
(Units Shipped)

Switzerland	1990	1991	1992	1993	1994	CAGR 90-92 %	CAGR 92-94 %
Large scale systems	53	51	55	59	63	1.9	7.0
Medium scale systems	839	622	670	750	790	- 10.6	8.6
Small scale systems	8,160	5,126	5,640	6,130	6,470	- 16.9	7.1
Workstations	6,233	7,553	10,051	13,416	16,455	27.0	28.0
PCs - professional market	209,000	226,000	238,000	258,000	277,000	6.7	7.9
PCs - home market	103,000	118,000	124,000	135,000	155,000	9.7	11.8
PC printers	259,235	289,519	352,213	404,883	456,541	16.6	13.9
Typewriters	107,000	104,507	90,455	84,835	77,339	- 8.1	- 7.5
Calculators	1,000,000	936,036	914,836	920,950	927,988	- 4.4	0.7
Copiers	65,000	67,764	71,228	71,962	78,799	4.7	5.2
LAN hardware	90,600	118,300	132,300	149,000	161,000	20.8	10.3

UK	1990	1991	1992	1993	1994	CAGR 90–92 %	CAGR 92–94 %
Large scale systems	219	191	190	195	198	- 6.9	2.1
Medium scale systems	3,115	2,520	2,650	2,800	3,000	- 7.8	6.4
Small scale systems	28,714	26,100	27,500	28,000	29,000	- 2.1	2.7
Workstations	20,555	27,598	36,467	52,950	73,653	33.2	42.1
PCs - professional market	1,084,000	1,182,000	1,251,000	1,351,000	1,457,000	7.4	7.9
PCs - home market	332,000	362,000	364,000	387,000	432,000	4.7	8.9
PC printers	1,125,667	1,124,560	1,291,241	1,424,597	1,555,723	7.1	9.8
Typewriters	480,000	463,574	401,559	395,651	339,173	- 8.5	- 8.1
Calculators	4,100,000	4,125,567	4,176,553	4,532,645	4,468,120	0.9	3.4
Copiers	330,000	334,582	341,077	350,746	353,607	1.7	1.8
LAN hardware	431,200	564,800	705,600	799,700	861,700	27.9	10.5

Table 42
UK
IT Market
(Units Shipped)

Eastern Europe	1991	1992	1993	1994		CAGR 92–94 %
Large scale systems	72	18	34	54		73.2
Medium scale systems	346	153	199	261		30.6
Small scale systems	12,239	1,925	2,485	3,180		28.5
Workstations	1,366	1,805	2,270	3,070		30.4
PCs - professional market	495,560	525,000	677,000	896,000		30.6
PCs - home market	120,000	75,000	65,000	65,000		- 6.9
PC printers	455,450	469,150	593,490	698,970		22.1
Typewriters	N/A	N/A	N/A	N/A		N/A
Calculators	N/A	N/A	N/A	N/A		N/A
Copiers	57,400	61,000	65,700	78,300		13.3
LAN hardware	153,000	196,800	258,200	400,000		42.6

Table 43
Eastern Europe
IT Market
(Units Shipped)

Former Czechoslovakia	1991	1992	1993	1994		CAGR 92–94 %
Large scale systems	6	6	9	13		47.2
Medium scale systems	42	45	60	75		29.1
Small scale systems	681	780	840	910		8.0
Workstations	250	420	610	820		39.7
PCs - professional market	96,100	118,000	135,000	162,000		17.2
PCs - home market	15,000	10,000	7,500	5,000		- 29.3
PC printers	81,000	96,000	112,000	132,000		17.3
Typewriters	N/A	N/A	N/A	N/A		N/A
Calculators	N/A	N/A	N/A	N/A		N/A
Copiers	13,500	13,800	14,900	16,300		8.7
LAN hardware	48,000	59,000	67,500	81,000		17.2

Table 44
Former
Czechoslovakia
IT Market
(Units Shipped)

Table 45
Hungary
IT Market
(Units Shipped)

Hungary	1991	1992	1993	1994		CAGR 92-94 %
Large scale systems	3	3	4	6		41.4
Medium scale systems	55	50	55	60		9.5
Small scale systems	355	380	410	450		8.8
Workstations	168	380	500	650		30.8
PCs - professional market	70,540	85,000	102,000	127,000		22.2
PCs - home market	15,000	10,000	7,500	5,000		- 29.3
PC printers	63,000	77,040	95,430	110,545		19.8
Typewriters	N/A	N/A	N/A	N/A		N/A
Calculators	N/A	N/A	N/A	N/A		N/A
Copiers	10,100	12,000	13,000	14,500		9.9
LAN hardware	42,000	51,000	61,200	76,200		22.2

Table 46
Poland
IT Market
(Units Shipped)

Poland	1991	1992	1993	1994		CAGR 92-94 %
Large scale systems	3	4	6	10		58.1
Medium scale systems	14	23	34	51		48.9
Small scale systems	403	465	535	620		15.5
Workstations	167	185	260	450		56.0
PCs - professional market	90,340	112,000	130,000	157,000		18.4
PCs - home market	60,000	35,000	20,000	15,000		- 34.5
PC printers	99,250	121,110	136,060	146,425		10.0
Typewriters	N/A	N/A	N/A	N/A		N/A
Calculators	N/A	N/A	N/A	N/A		N/A
Copiers	9,800	11,100	12,300	13,800		11.5
LAN hardware	35,000	44,800	52,000	62,800		18.4

Table 47
Former Soviet Union
IT Market
(Units Shipped)

Former Soviet Union	1991	1992	1993	1994		CAGR 92-94 %
Large scale systems	60	5	15	25		123.6
Medium scale systems	235	35	50	75		46.4
Small scale systems	10,800	300	700	1,200		100.0
Workstations	781	820	900	1,150		18.4
PCs - professional market	238,580	210,000	310,000	450,000		46.4
PCs - home market	30,000	20,000	30,000	40,000		41.4
PC printers	212,200	175,000	250,000	310,000		33.1
Typewriters	N/A	N/A	N/A	N/A		N/A
Calculators	N/A	N/A	N/A	N/A		N/A
Copiers	24,000	24,100	25,500	33,700		18.3
LAN hardware	28,000	42,000	77,500	180,000		107.0

EC	1992	1993	1994	CAGR 92-94 %
Large scale systems	9,736	9,401	9,109	- 3.3
Medium scale systems	139,780	138,400	137,780	- 0.7
Small scale systems	1,148,400	1,135,900	1,135,000	- 0.6
Workstations	455,201	627,751	857,414	37.2
PCs - professional market	20,405,000	22,106,000	23,754,000	7.9
PCs - home market	10,303,000	11,008,000	11,899,000	7.5
Typewriters	10,651,580	11,018,032	11,004,306	1.6
Calculators	86,995,213	89,069,797	91,429,541	2.5
Copiers	6,201,701	6,439,590	6,685,666	3.8
LAN hardware	8,687,700	11,186,800	13,699,900	25.6

Table 48
EC
IT Market
(Units Installed)

EFTA	1992	1993	1994	CAGR 92-94 %
Large scale systems	1,229	1,244	1,283	2.2
Medium scale systems	23,030	23,310	23,710	1.5
Small scale systems	154,800	157,300	162,800	2.6
Workstations	95,617	127,119	166,201	31.8
PCs - professional market	3,326,000	3,636,000	3,938,000	8.8
PCs - home market	1,061,000	1,188,000	1,326,000	11.8
Typewriters	1,613,673	1,642,340	1,606,945	- 0.2
Calculators	12,844,738	13,116,808	13,457,094	2.4
Copiers	1,116,308	1,137,480	1,155,939	1.8
LAN hardware	1,767,500	2,282,400	2,803,500	25.9

Table 49
EFTA
IT Market
(Units Installed)

EC + EFTA	1992	1993	1994	CAGR 92-94 %
Large scale systems	10,965	10,645	10,392	- 2.6
Medium scale systems	162,810	161,710	161,490	- 0.4
Small scale systems	1,303,200	1,293,200	1,297,800	- 0.2
Workstations	550,818	754,870	1,023,615	36.3
PCs - professional market	23,731,000	25,742,000	27,692,000	8.0
PCs - home market	11,364,000	12,196,000	13,225,000	7.9
Typewriters	12,265,254	12,660,372	12,611,250	1.4
Calculators	99,839,952	102,186,605	104,886,635	2.5
Copiers	7,318,009	7,577,069	7,841,605	3.5
LAN hardware	10,455,200	13,469,200	16,503,400	25.6

Table 50
EC + EFTA
IT Market
(Units Installed)

Table 51
Austria
IT Market
(Units Installed)

Austria	1992	1993	1994	CAGR 92-94 %
Large scale systems	271	265	268	- 0.6
Medium scale systems	4,040	4,260	4,450	5.0
Small scale systems	32,900	34,900	36,800	5.8
Workstation	14,061	19,513	27,260	39.2
PCs - professional market	414,000	466,000	520,000	12.1
PCs - home market	196,000	215,000	240,000	10.7
Typewriters	203,186	211,655	212,655	2.3
Calculators	1,709,897	1,818,617	1,918,892	5.9
Copiers	128,248	129,886	131,934	1.4
LAN hardware	161,700	209,300	258,000	26.3

Table 52
Belgium/Luxembourg
IT Market
(Units Installed)

Belgium/Luxembourg	1992	1993	1994	CAGR 92-94 %
Large scale systems	424	414	407	- 2.0
Medium scale systems	3,870	3,830	3,830	- 0.5
Small scale systems	39,600	40,700	42,500	3.6
Workstation	12,801	19,226	27,920	47.7
PCs - professional market	697,000	747,000	790,000	6.5
PCs - home market	344,000	319,000	311,000	- 4.9
Typewriters	349,972	356,388	340,353	- 1.4
Calculators	2,623,361	2,663,867	2,706,377	1.6
Copiers	223,487	227,570	235,006	2.5
LAN hardware	287,500	367,200	441,200	23.9

Table 53
Denmark
IT Market
(Units Installed)

Denmark	1992	1993	1994	CAGR 92-94 %
Large scale systems	237	253	269	6.5
Medium scale systems	2,960	3,030	3,080	2.0
Small scale systems	17,800	18,200	19,700	5.2
Workstation	9,019	11,382	14,809	28.1
PCs - professional market	580,000	646,000	695,000	9.5
PCs - home market	159,000	191,000	221,000	17.9
Typewriters	263,844	269,641	267,750	0.7
Calculators	2,076,115	2,127,965	2,186,412	2.6
Copiers	195,170	200,923	209,975	3.7
LAN hardware	340,000	443,900	545,900	26.7

Finland	1992	1993	1994	CAGR 92-94 %
Large scale systems	141	147	155	4.8
Medium scale systems	2,100	2,050	2,050	- 1.2
Small scale systems	15,700	15,600	16,100	1.3
Workstation	10,667	13,104	16,224	23.3
PCs - professional market	512,000	531,000	578,000	6.3
PCs - home market	85,000	84,000	91,000	3.5
Typewriters	208,281	211,017	204,066	- 1.0
Calculators	1,623,632	1,694,100	1,741,473	3.6
Copiers	172,144	174,856	177,605	1.6
LAN hardware	340,200	436,300	532,100	25.1

Table 54
Finland
IT Market
(Units Installed)

France	1992	1993	1994	CAGR 92-94 %
Large scale systems	1,729	1,690	1,648	- 2.4
Medium scale systems	25,990	25,410	24,920	- 2.1
Small scale systems	225,800	221,300	219,500	- 1.4
Workstation	92,320	124,823	167,710	34.8
PCs - professional market	3,840,000	4,129,000	4,399,000	7.0
PCs - home market	1,504,000	1,579,000	1,712,000	6.7
Typewriters	1,816,786	1,833,099	1,783,269	- 0.9
Calculators	15,069,387	15,549,678	15,781,237	2.3
Copiers	1,260,866	1,289,053	1,329,382	2.7
LAN hardware	1,727,200	2,159,600	2,573,000	22.1

Table 55
France
IT Market
(Units Installed)

Germany	1992	1993	1994	CAGR 92-94 %
Large scale systems	3,335	3,193	3,047	- 4.4
Medium scale systems	37,410	37,450	37,510	0.1
Small scale systems	266,800	266,000	266,800	0.0
Workstation	144,784	203,735	279,862	39.0
PCs - professional market	4,944,000	5,422,000	5,887,000	9.1
PCs - home market	4,135,000	4,772,000	5,369,000	13.9
Typewriters	3,158,276	3,395,594	3,543,761	5.9
Calculators	25,531,012	26,879,865	28,077,613	4.9
Copiers	1,189,382	1,345,490	1,475,704	11.4
LAN hardware	2,208,300	2,880,200	3,572,400	27.2

Table 56
Germany
IT Market
(Units Installed)

Table 57
Italy
IT Market
(Units Installed)

Italy	1992	1993	1994	CAGR 92-94 %
Large scale systems	1,062	1,001	956	- 5.1
Medium scale systems	25,780	25,960	26,170	0.8
Small scale systems	213,700	209,400	207,700	- 1.4
Workstations	42,475	54,807	72,064	30.3
PCs - professional market	2,425,000	2,667,000	2,920,000	9.7
PCs - home market	1,066,000	1,071,000	1,074,000	0.4
Typewriters	1,219,563	1,272,341	1,262,399	1.7
Calculators	9,837,655	10,053,494	10,479,933	3.2
Copiers	793,141	809,368	828,509	2.2
LAN hardware	670,200	876,700	1,090,000	27.5

Table 58
Netherlands
IT Market
(Units Installed)

Netherlands	1992	1993	1994	CAGR 92-94 %
Large scale systems	471	463	455	- 1.7
Medium scale systems	8,580	8,740	9,000	2.4
Small scale systems	54,800	53,700	51,500	- 3.1
Workstation	26,862	35,199	44,427	28.6
PCs - professional market	1,636,000	1,733,000	1,824,000	5.6
PCs - home market	471,000	480,000	484,000	1.4
Typewriters	731,741	756,543	742,127	0.7
Calculators	6,201,747	6,220,263	6,183,098	- 0.2
Copiers	533,536	541,525	555,666	2.1
LAN hardware	572,200	734,000	898,500	25.3

Table 59
Norway
IT Market
(Units Installed)

Norway	1992	1993	1994	CAGR 92-94 %
Large scale systems	116	116	120	1.7
Medium scale systems	4,210	4,160	4,170	- 0.5
Small scale systems	21,100	21,500	22,600	3.5
Workstation	12,219	15,304	18,582	23.3
PCs - professional market	595,000	670,000	731,000	10.8
PCs - home market	107,000	116,000	124,000	7.7
Typewriters	280,781	287,221	284,086	0.6
Calculators	2,027,516	2,050,950	2,057,599	0.7
Copiers	205,953	210,342	212,420	1.6
LAN hardware	258,900	336,800	417,900	27.0

Spain	1992	1993	1994	CAGR 92-94 %
Large scale systems	531	543	564	3.1
Medium scale systems	6,660	6,950	7,230	4.2
Small scale systems	74,900	81,800	90,800	10.1
Workstation	14,837	25,060	39,805	63.8
PCs - professional market	1,642,000	1,768,000	1,879,000	7.0
PCs - home market	885,000	891,000	944,000	3.3
Typewriters	879,574	902,770	883,672	0.2
Calculators	7,199,411	7,186,588	7,323,407	0.9
Copiers	551,064	564,191	575,348	2.2
LAN hardware	562,700	741,400	916,900	27.7

Table 60
Spain
IT Market
(Units Installed)

Sweden	1992	1993	1994	CAGR 92-94 %
Large scale systems	276	284	296	3.6
Medium scale systems	5,920	5,930	5,960	0.3
Small scale systems	32,500	33,800	36,100	5.4
Workstation	27,347	37,686	50,653	36.1
PCs - professional market	959,000	1,036,000	1,099,000	7.1
PCs - home market	217,000	248,000	274,000	12.4
Typewriters	420,125	430,927	420,085	0.0
Calculators	3,455,388	3,536,510	3,725,374	3.8
Copiers	314,759	323,861	332,147	2.7
LAN hardware	586,800	759,500	933,400	26.1

Table 61
Sweden
IT Market
(Units Installed)

Switzerland	1992	1993	1994	CAGR 92-94 %
Large scale systems	425	432	444	2.2
Medium scale systems	6,760	6,910	7,080	2.3
Small scale systems	52,600	51,500	51,200	- 1.3
Workstation	31,323	41,512	53,482	30.7
PCs - professional market	846,000	933,000	1,010,000	9.3
PCs - home market	456,000	525,000	597,000	14.4
Typewriters	501,300	501,521	486,052	- 1.5
Calculators	4,028,304	4,016,631	4,013,756	- 0.2
Copiers	295,204	298,535	301,834	1.1
LAN hardware	419,900	540,500	662,100	25.6

Table 62
Switzerland
IT Market
(Units Installed)

Table 63
UK
IT Market
(Units Installed)

UK	1992	1993	1994	CAGR 92-94 %
Large scale systems	1,947	1,844	1,763	- 4.8
Medium scale systems	28,530	27,030	26,040	- 4.5
Small scale systems	255,000	244,800	236,500	- 3.7
Workstation	112,103	153,518	210,816	37.1
PCs - professional market	4,641,000	4,994,000	5,360,000	7.5
PCs - home market	1,739,000	1,705,000	1,784,000	1.3
Typewriters	2,231,825	2,231,656	2,180,976	- 1.1
Calculators	18,456,524	18,388,076	18,691,464	0.6
Copiers	1,455,055	1,461,469	1,476,077	0.7
LAN hardware	2,319,600	2,983,800	3,662,000	25.6

7. EC Trade Flows

The data presented on trade is based upon the Combined Nomenclature, an international standard for such data. The details concerning the product categories included is given at the end of the statistical section. In general terms, the trade data can be considered to match well but not exactly with the classification used for IT hardware throughout the statistical section. Data processing equipment, electronic office equipment and components and related spares are all included. However, certain categories of data communications products are not included in the trade data used, but the inclusion of such products would not significantly alter the level or trend of the data presented. This exclusion is made necessary due to the nature of the classification scheme.

Figures are presented in current ECU, according to standard valuation rules. Imports are generally stated at customs value or by reference to the concept of customs value (cif); exports are stated at the value of the goods at the place and time that they leave the statistical area of the exporting member state (fob). The focus of the following analysis is the European Community. Data availability for membership countries is governed within the framework of the Community's statistical systems.

The term intra-EC refers to trade between member states. Extra-EC trade is that between a member state and a non-member state. It should be noted that intra-EC import statistics are based upon the country of consignment, and not necessarily on the country of origin.

The EC runs a substantial deficit with the rest of the World in trade in IT products. In 1992 the gap between total imports and exports is likely to amount to a little in excess of ECU 17 billion, compared with a figure of just under ECU 12 billion in 1989. If intra-EC trade only is measured the deficit closes to ECU 14 billion, or roughly 13% of the total EC market for such products. At the level of the individual EC member states the story is similar, with a single exception. The Republic of Ireland is the only member state to run a surplus in trade in IT products.

The existence of an IT hardware trade deficit indicates that a degree of European demand is being satisfied by imports from beyond the EC's borders. The other side of the same argument focuses on the extent of production within the EC. *Tables 64* and *65* illustrate two basic points about production within the Community. The first is that the majority of IT hardware production is concentrated within 6 nations; Germany, France, the UK, Italy, Ireland and Spain. Together these six countries produce over 93% of total EC IT hardware value. The second point is that looking beyond hardware to include the increasingly important sectors of software and services, the EC position is more favourable, particularly with respect to services and support functions, which are far harder to trade. Comparing the value of hardware production with the EC market reveals a ratio of 67%; the same calculation repeated to the total market results in a ratio of 76%.

IT hardware trade data for the EC and for the member states from 1990, 1991 and estimated values for 1992 are presented in current ECU in *tables 66* to *77*.

Table 64
EC IT Hardware Production 1992 (ECU Millions)

Producing country	Production Value	% Total EC Production
Germany	10,355	29.5
France	6,822	19.4
UK	6,520	18.6
Italy	4,586	13.0
Ireland	2,455	7.0
Spain	2,098	6.0
Top 6	32,836	93.4
Total EC	35,143	100.0

Table 65
Comparison of EC Market Value and Production Value 1992 (ECU Billions)

Product type	Production Value	Market Value	Production market %
IT hardware	35.1	52.3	67.1
Packaged software	7.5	16.5	45.5
Services	28.4	29.1	97.6
Hardware maintenance & support	11.9	11.9	100.0
Total	82.9	109.8	75.5

Table 66
EC Trade in IT Hardware (Thousands of ECU)

EC	1990	1991	1992
Imports Intra-EC	29,276,813	30,635,538	29,941,166
Imports Extra-EC	24,276,272	26,569,614	26,616,848
Imports Total	53,553,085	57,205,152	56,558,014
Exports Intra-EC	28,231,811	28,048,384	26,902,172
Exports Extra-EC	11,828,704	12,673,936	12,542,320
Exports Total	40,060,515	40,722,320	39,444,492
Extra-EC/Intra-EC Exports	41.9%	45.2%	46.6%
Extra-EC/Intra-EC Imports	82.9%	86.7%	88.9%
Trade Balance	- 13,492,570	- 16,482,832	- 17,113,522
Extra-EC Trade Balance	- 12,447,568	- 13,895,678	- 14,074,528

Belgium/Luxembourg	1990	1991	1992
Imports Intra-EC	1,750,306	1,691,073	1,674,148
Imports Extra-EC	527,317	545,622	607,428
Imports Total	2,277,623	2,236,695	2,281,576
Exports Intra-EC	849,535	830,763	761,008
Exports Extra-EC	154,678	168,067	161,682
Exports Total	1,004,213	998,830	922,690
Extra-EC/Intra-EC Exports	18.2%	20.2%	21.2%
Extra-EC/Intra-EC Imports	30.1%	32.3%	36.3%
Trade Balance	- 1,273,410	- 1,237,865	- 1,358,886
Extra-EC Trade Balance	- 372,639	- 377,555	- 445,746

Table 67
Belgium/Luxembourg
Trade in IT Hardware
(Thousands of ECU)

Denmark	1990	1991	1992
Imports Intra-EC	836,995	982,158	971,022
Imports Extra-EC	383,111	362,738	376,054
Imports Total	1,220,106	1,344,896	1,347,076
Exports Intra-EC	272,613	244,755	239,656
Exports Extra-EC	221,919	328,300	310,190
Exports Total	494,532	573,055	549,846
Extra-EC/Intra-EC Exports	81.4%	134.1%	129.4%
Extra-EC/Intra-EC Imports	45.8%	36.9%	38.7%
Trade Balance	- 725,574	- 771,841	- 797,230
Extra-EC Trade Balance	- 161,192	- 34,438	- 65,864

Table 68
Denmark
Trade in IT Hardware
(Thousands of ECU)

Table 69
France
Trade in IT Hardware
(Thousands of ECU)

France	1990	1991	1992
Imports Intra-EC	5,489,827	5,557,684	5,307,914
Imports Extra-EC	3,068,033	3,008,644	3,207,212
Imports Total	8,557,860	8,566,328	8,515,126
Exports Intra-EC	3,562,023	3,977,513	3,784,174
Exports Extra-EC	1,491,132	1,540,282	1,578,162
Exports Total	5,053,155	5,517,795	5,362,336
Extra-EC/Intra-EC Exports	41.9%	38.7%	41.7%
Extra-EC/Intra-EC Imports	55.9%	54.1%	60.4%
Trade Balance	- 3,504,705	- 3,048,533	- 3,152,790
Extra-EC Trade Balance	- 1,576,901	- 1,468,362	- 1,629,050

Table 70
Germany
Trade in IT Hardware
(Thousands of ECU)

Germany	1990	1991	1992
Imports Intra-EC	5,663,278	6,535,011	6,146,952
Imports Extra-EC	6,414,639	7,641,508	7,950,244
Imports Total	12,077,917	14,176,519	14,097,196
Exports Intra-EC	6,222,619	5,899,924	5,787,370
Exports Extra-EC	3,787,247	4,329,559	4,065,414
Exports Total	10,009,866	10,229,483	9,852,784
Extra-EC/Intra-EC Exports	60.9%	73.4%	70.2%
Extra-EC/Intra-EC Imports	113.3%	116.9%	129.3%
Trade Balance	- 2,068,051	- 3,947,036	- 4,244,412
Extra-EC Trade Balance	- 2,627,392	- 3,311,949	- 3,884,830

Greece	1990	1991	1992
Imports Intra-EC	157,597	194,955	190,472
Imports Extra-EC	97,365	131,483	122,786
Imports Total	254,962	326,438	313,258
Exports Intra-EC	3,070	5,937	5,186
Exports Extra-EC	2,075	4,094	2,328
Exports Total	5,145	10,031	7,514
Extra-EC/Intra-EC Exports	67.6%	69.0%	44.9%
Extra-EC/Intra-EC Imports	61.8%	67.4%	64.5%
Trade Balance	- 249,817	- 316,407	- 305,744
Extra-EC Trade Balance	- 95,290	- 127,389	- 120,458

Table 71
Greece
Trade in IT Hardware
(Thousands of ECU)

Ireland	1990	1991	1992
Imports Intra-EC	651,338	676,871	790,938
Imports Extra-EC	1,066,813	1,097,846	679,852
Imports Total	1,718,151	1,774,717	1,470,790
Exports Intra-EC	2,834,952	2,385,263	2,479,814
Exports Extra-EC	776,640	866,946	1,038,880
Exports Total	3,611,592	3,252,209	3,518,694
Extra-EC/Intra-EC Exports	27.4%	36.3%	41.9%
Extra-EC/Intra-EC Imports	163.8%	162.2%	86.0%
Trade Balance	1,893,441	1,477,492	2,047,904
Extra-EC Trade Balance	- 290,173	- 230,900	359,028

Table 72
Ireland
Trade in IT Hardware
(Thousands of ECU)

Table 73
Italy
Trade in IT Hardware
(Thousands of ECU)

Italy	1990	1991	1992
Imports Intra-EC	3,228,825	3,489,521	3,418,132
Imports Extra-EC	1,730,801	1,752,151	1,768,788
Imports Total	4,959,626	5,241,672	5,186,920
Exports Intra-EC	2,839,421	2,936,752	2,692,974
Exports Extra-EC	1,019,367	884,995	946,054
Exports Total	3,858,788	3,821,747	3,639,028
Extra-EC/Intra-EC Exports	35.9%	30.1%	35.1%
Extra-EC/Intra-EC Imports	53.6%	50.2%	51.7%
Trade Balance	- 1,100,838	- 1,419,925	- 1,547,892
Extra-EC Trade Balance	- 711,434	- 867,156	- 822,734

Table 74
Netherlands
Trade in IT Hardware
(Thousands of ECU)

Netherlands	1990	1991	1992
Imports Intra-EC	3,911,436	3,865,612	3,914,668
Imports Extra-EC	3,696,508	4,449,345	4,210,982
Imports Total	7,607,944	8,314,957	8,125,650
Exports Intra-EC	4,946,022	4,651,131	4,604,164
Exports Extra-EC	1,357,588	1,309,193	1,316,214
Exports Total	6,303,610	5,960,324	5,920,378
Extra-EC/Intra-EC Exports	27.4%	28.1%	28.6%
Extra-EC/Intra-EC Imports	94.5%	115.1%	107.6%
Trade Balance	- 1,304,334	- 2,354,633	- 2,205,272
Extra-EC Trade Balance	- 2,338,920	- 3,140,152	- 2,894,768

Portugal	1990	1991	1992
Imports Intra-EC	427,712	518,005	461,190
Imports Extra-EC	135,646	169,279	150,436
Imports Total	563,358	687,284	611,626
Exports Intra-EC	45,945	43,308	37,762
Exports Extra-EC	33,512	34,410	24,392
Exports Total	79,457	77,718	62,154
Extra-EC/Intra-EC Exports	72.9%	79.5%	64.6%
Extra-EC/Intra-EC Imports	31.7%	32.7%	32.6%
Trade Balance	- 483,901	- 609,566	- 549,472
Extra EC-Trade Balance	- 102,134	- 134,869	- 126,044

Table 75
Portugal
Trade in IT Hardware
(Thousands of ECU)

Spain	1990	1991	1992
Imports Intra-EC	1,623,333	1,876,556	1,565,316
Imports Extra-EC	1,399,095	1,555,233	1,496,726
Imports Total	3,022,428	3,431,789	3,062,042
Exports Intra-EC	726,862	919,772	738,924
Exports Extra-EC	188,366	263,089	228,728
Exports Total	915,228	1,182,861	967,652
Extra-EC/Intra-EC Exports	25.9%	28.6%	31.0%
Extra-EC/Intra-EC Imports	86.2%	82.9%	95.6%
Trade Balance	- 2,107,200	- 2,248,928	- 2,094,390
Extra-EC Trade Balance	- 1,210,729	- 1,292,144	- 1,267,998

Table 76
Spain
Trade in IT Hardware
(Thousands of ECU)

Table 77
UK
Trade in IT Hardware
(Thousands of ECU)

UK	1990	1991	1992
Imports Intra-EC	5,536,166	5,248,092	5,500,414
Imports Extra-EC	5,756,944	5,855,765	6,046,328
Imports Total	11,293,110	11,103,857	11,546,742
Exports Intra-EC	5,928,749	6,153,266	5,771,140
Exports Extra-EC	2,796,180	2,945,001	2,870,276
Exports Total	8,724,929	9,098,267	8,641,416
Extra-EC/Intra-EC Exports	47.2%	47.9%	49.7%
Extra-EC/Intra-EC Imports	104.0%	111.6%	109.9%
Trade Balance	- 2,568,181	- 2,005,590	- 2,905,326
Extra-EC Trade Balance	- 2,960,764	- 2,910,764	- 3,176,052

8. Market Structures and Penetration of IT

The different markets in Europe freely share certain features with their neighbours, but equally the degree of variation amongst the countries is also considerable. The tables which follow attempt to illustrate the degree to which countries within the EC and EFTA are distinguished in terms of their competitive fabric, trade balance (EC countries only) and overall use of IT.

Throughout the EC and EFTA the ratios of the value of the IT market compared to gross national product, or of the IT market value to the total population, varies considerably. *Tables 78* and *79* summarise the variation of these ratios by country for the period 1990 to 1992.

Tables 80 to *92* present a number of ratios for the major EC and EFTA markets. These tables include different measures of industry leadership or concentration, ratios comparing the value of the IT market to gross domestic product and population, and a series of trade related measures for the EC member states.

The market share of a leader in a particular market is for the purposes of this study considered a composite measure. The nature of the IT market in Europe makes this a necessity. Thus, it cannot be assumed that a figure under this heading gives the total market share of a single national supplier. The composite measure is designed to assess the degree to which the market leaders in various related sectors dominate those markets. A similar principle is used in arriving at a figure for market concentration. These figures refer to the cumulative market share of the top ten vendors, in each year, with the composition of the top ten varying each year. The software and services markets are here defined in terms which stress the independent structures. They are not therefore sensitive to the balance of power between the traditional hardware suppliers and the independent specialists. This is justified on the basis of the theory of de-integration of the industry and because of the predominance of the hardware suppliers in terms of the systems software that is essential for the operation of the machines, but not intimately associated with the solution of user oriented problems.

Due to the structure of the statistical reporting system trade related ratios only cover trade in hardware. The ratios presented focus on trade between the EC member state and non-members extra-EC trade. Thus, the export/import ratio compares extra-EC exports to extra-EC imports; import penetration refers to extra-EC imports compared with the domestic hardware market; and the export rate measures extra-EC exports compared to production of hardware.

Table 78
IT Market Value as % of GDP

	1990 %	1991 %	1992 %
Austria	1.87	1.82	1.87
Belgium/Luxembourg	2.41	2.46	2.53
Denmark	2.98	3.02	3.04
Finland	2.24	2.18	2.19
France	2.19	2.21	2.20
Germany	2.24	2.31	2.38
Greece	0.67	0.70	0.79
Ireland	1.61	1.66	1.72
Italy	1.49	1.54	1.58
Netherlands	3.01	3.02	3.09
Norway	2.85	2.98	2.88
Portugal	1.31	1.38	1.59
Spain	1.48	1.56	1.60
Sweden	3.00	3.04	2.98
Switzerland	3.10	3.04	3.12
UK	2.58	2.57	2.60
EC + EFTA	2.18	2.21	2.25
US	2.58	2.71	2.79
Japan	2.28	2.43	2.50

Table 79
Per Capita IT Market Value (ECU/Per Capita)

	1990	1991	1992
Austria	306	310	326
Belgium/Luxembourg	367	389	406
Denmark	615	634	651
Finland	465	454	452
France	372	383	389
Germany	335	360	377
Greece	35	39	45
Ireland	158	167	177
Italy	226	239	250
Netherlands	448	467	484
Norway	583	620	610
Portugal	61	77	91
Spain	149	163	172
Sweden	633	646	630
Switzerland	821	822	851
UK	343	346	351
EC + EFTA	317	331	341
US	451	467	491
Japan	440	490	512

Table 80
Austria
IT Market Structures and Penetration of IT

Austria		1990	1991	1992
Industry Leader's Share	Hardware	28.8%	28.0%	27.0%
	Software	0.6%	0.8%	1.2%
	Services	1.5%	1.8%	2.2%
Industry Concentration (top 10 vendors)	Hardware	80.2%	73.7%	72.0%
	Software	3.9%	5.3%	8.4%
	Services	9.8%	12.6%	15.4%
Market Comparisons	IT Market versus GDP	1.87%	1.82%	1.87%
	Per Capita IT Expenditure (ECU)	306	310	326

Belgium/Luxembourg		1990	1991	1992
Industry Leader's Share	Hardware	31.3%	27.8%	27.0%
	Software	2.0%	2.1%	2.4%
	Services	1.8%	2.5%	4.5%
Industry Concentration (top 10 vendors)	Hardware	79.4%	76.5%	75.0%
	Software	12.2%	12.6%	14.6%
	Services	8.2%	12.2%	18.0%
Trade in Hardware	Export/Import Ratio	29.3%	30.8%	26.6%
	Import Penetration	28.9%	28.9%	31.9%
	Export Rate	28.1%	25.9%	29.8%
Market Comparisons	IT Market versus GDP	2.41%	2.46%	2.53%
	Per Capita IT Expenditure (ECU)	367	389	406

Table 81
Belgium/Luxembourg
IT Market Structures and Penetration of IT

Denmark		1990	1991	1992
Industry Leader's Share	Hardware	47.7%	43.9%	41.0%
	Software	2.2%	2.3%	2.4%
	Services	11.1%	11.7%	11.6%
Industry Concentration (top 10 vendors)	Hardware	85.6%	82.2%	79.9%
	Software	12.4%	12.7%	13.0%
	Services	31.7%	31.0%	2.8%
Trade in Hardware	Export/Import Ratio	57.9%	90.5%	82.5%
	Import Penetration	26.0%	24.8%	26.0%
	Export Rate	29.7%	47.4%	47.6%
Market Comparisons	IT Market Versus GDP	2.98%	3.02%	3.04%
	Per Capita IT Expenditure (ECU)	615	634	651

Table 82
Denmark
IT Market Structures and Penetration of IT

Finland		1990	1991	1992
Industry Leader's Share	Hardware	25.1%	22.3%	19.0%
	Software	11.3%	9.0%	10.0%
	Services	10.4%	16.4%	16.7%
Industry Concentration (top 10 vendors)	Hardware	76.3%	69.1%	67.0%
	Software	40.2%	33.8%	34.0%
	Services	34.2%	46.5%	47.1%
Market Comparisons	IT Market versus GDP	2.24%	2.18%	2.19%
	Per Capita IT Expenditure (ECU)	465	454	452

Table 83
Finland
IT Market Structures and Penetration of IT

Table 84
France
IT Market Structures and Penetration of IT

France		1990	1991	1992
Industry Leader's Share	Hardware	28.1%	26.6%	25.0%
	Software	6.0%	6.8%	7.0%
	Services	12.8%	12.8%	12.7%
Industry Concentration (top 10 vendors)	Hardware	79.0%	76.6%	70.0%
	Software	42.0%	23.5%	0.0%
	Services	72.7%	23.5%	0.0%
Trade in Hardware	Export/Import Ratio	48.6%	51.2%	49.2%
	Import Penetration	29.3%	29.4%	32.2%
	Export Rate	21.4%	24.1%	23.1%
Market Comparisons	IT Market versus GDP	2.19%	2.21%	2.20%
	Per Capita IT Expenditure (ECU)	372	383	389

Table 85
Germany
IT Market Structures and Penetration of IT

Germany		1990	1991	1992
Industry Leader's Share	Hardware	26.6%	29.7%	30.0%
	Software	3.3%	3.4%	3.5%
	Services	2.2%	1.9%	2.1%
Industry Concentration (top 10 vendors)	Hardware	73.3%	75.2%	75.0%
	Software	16.2%	12.9%	13.0%
	Services	11.6%	9.9%	10.0%
Trade in Hardware	Export/Import Ratio	59.0%	56.7%	51.1%
	Import Penetration	45.2%	52.0%	54.5%
	Export Rate	31.2%	40.3%	39.3%
Market Comparisons	IT Market versus GDP	2.24%	2.31%	2.38%
	Per Capita IT Expenditure (ECU)	355	360	377

Table 86
Italy
IT Market Structures and Penetration of IT

Italy		1990	1991	1992
Industry Leader's Share	Hardware	33.8%	33.1%	33.0%
	Software	2.5%	2.3%	2.0%
	Services	15.9%	16.2%	16.0%
Industry Concentration (top 10 vendors)	Hardware	90.2%	78.9%	76.0%
	Software	14.5%	14.0%	13.5%
	Services	44.3%	45.0%	45.2%
Trade in Hardware	Export/Import Ratio	58.9%	50.5%	53.5%
	Import Penetration	27.2%	28.2%	28.8%
	Export Rate	19.4%	18.5%	20.6%
Market Comparisons	IT Market versus GDP	1.49%	1.54%	1.58%
	Per Capita IT Expenditure (ECU)	226	239	250

Netherlands		1990	1991	1992
Industry Leader's Share	Hardware	24.9%	23.0%	23.0%
	Software	3.2%	2.3%	2.5%
	Services	19.2%	14.3%	14.5%
Industry Concentration (top 10 vendors)	Hardware	78.1%	74.7%	71.0%
	Software	15.0%	12.0%	15.0%
	Services	65.7%	58.1%	59.0%
Trade in Hardware	Export/Import Ratio	36.7%	29.4%	31.3%
	Import Penetration	109.2%	132.2%	129.7%
	Export Rate	65.3%	129.4%	126.4%
Market Comparisons	IT Market versus GDP	3.01%	3.02%	3.09%
	Per Capita IT Expenditure (ECU)	448	467	484

Table 87
Netherlands
IT Market Structures and Penetration of IT

Norway		1990	1991	1992
Industry Leader's Share	Hardware	25.1%	24.5%	24.5%
	Software	3.0%	4.1%	4.3%
	Services	3.3%	4.9%	5.1%
Industry Concentration (top 10 vendors)	Hardware	72.8%	66.3%	66.3%
	Software	18.0%	20.4%	22.0%
	Services	26.0%	27.7%	29.0%
Market Comparisons	IT Market versus GDP	2.85%	2.98%	2.88%
	Per Capita IT Expenditure (ECU)	583	620	610

Table 88
Norway
IT Market Structures and Penetration of IT

Spain		1990	1991	1992
Industry Leader's Share	Hardware	32.4%	28.8%	27.0%
	Software	4.8%	3.7%	3.9%
	Services	19.9%	13.0%	14.0%
Industry Concentration (top 10 vendors)	Hardware	77.5%	68.0%	67.0%
	Software	30.7%	11.7%	13.0%
	Services	40.7%	33.8%	35.0%
Trade in Hardware	Export/Import Ratio	13.5%	16.9%	15.3%
	Import Penetration	36.8%	37.7%	35.7%
	Export Rate	11.1%	14.0%	10.9%
Market Comparisons	IT Market versus GDP	1.48%	1.56%	1.60%
	Per Capita IT Expenditure (ECU)	149	163	172

Table 89
Spain
IT Market Structures and Penetration of IT

Table 90
Sweden
IT Market Structures and Penetration of IT

Sweden		1990	1991	1992
Industry Leader's Share	Hardware	35.9%	31.2%	31.0%
	Software	5.8%	2.5%	2.5%
	Services	9.3%	15.8%	16.0%
Industry Concentration (top 10 vendors)	Hardware	81.8%	81.3%	83.0%
	Software	24.7%	15.6%	16.0%
	Services	31.0%	33.9%	34.5%
Market Comparisons	IT Market versus GDP	3.00%	3.04%	3.12%
	Per Capita IT Expenditure (ECU)	633	646	630

Table 91
Switzerland
IT Market Structures and Penetration of IT

Switzerland		1990	1991	1992
Industry Leader's Share	Hardware	31.0%	26.2%	28.0%
	Software	0.1%	0.6%	0.7%
	Services	1.8%	1.6%	1.7%
Industry Concentration (top 10 vendors)	Hardware	77.6%	68.8%	67.0%
	Software	0.8%	3.8%	4.6%
	Services	11.8%	10.1%	11.1%
Market Comparisons	IT Market versus GDP	3.10%	3.04%	3.12%
	Per Capita IT Expenditure (ECU)	821	822	851

Table 92
UK
IT Market Structures and Penetration of IT

UK		1990	1991	1992
Industry Leader's Share	Hardware	22.3%	19.9%	19.7%
	Software	3.2%	4.8%	4.8%
	Services	4.7%	5.9%	5.8%
Industry Concentration (top 10 vendors)	Hardware	70.9%	72.4%	77.0%
	Software	14.7%	16.8%	16.8%
	Services	25.9%	32.7%	30.0%
Trade in Hardware	Export/Import Ratio	48.6%	50.3%	47.5%
	Import Penetration	55.0%	58.2%	64.1%
	Export Rate	35.4%	36.6%	44.0%
Market Comparisons	IT Market versus GDP	2.58%	2.57%	2.60%
	Per Capita IT Expenditure (ECU)	343	346	351

9. Technology, Price Dynamics and End User Issues

Technological Dynamics

The role of technological advancement in stimulating the growth of IT markets is a complex subject, but one which is often summarised in terms of "laws" which illustrate improvements in process technologies and device physics. The improved function of the basic processing and storage elements has led to continuous improvements in the capacity of affordable computers to process, store and present data; and in many ways this progress has been mirrored by the industry as a whole.

The observed evolution of the use of computer systems can be characterised by various quite distinct phases; phases which are often approximately aligned with the decades. Thus, the 1960s was the decade of the mainframe; the 1970s saw the rise of the minicomputer; the 1980s was the decade of the personal computer or personal workstation; and in the 1990s it is the turn of the distributed system. The rate of development of the computer industry is of itself quite staggering.

The shift in patterns of usage alluded to above deserves further elaboration. *Figure 6* illustrates a direct consequence of the rise of the new platforms over the decades. In the early 1970s, roughly 90% of organisations' processor cycles were executed on large centralised mainframes. Today, the situation is rather different, due to the extraordinary proliferation of small systems based upon cheap microprocessor technology. There has in fact been an inversion of the power pyramid. Today, organisations' processing has naturally become "distributed", even if in many cases the process has been relatively uncontrolled, and may not conform to a systems definition of distributed processing.

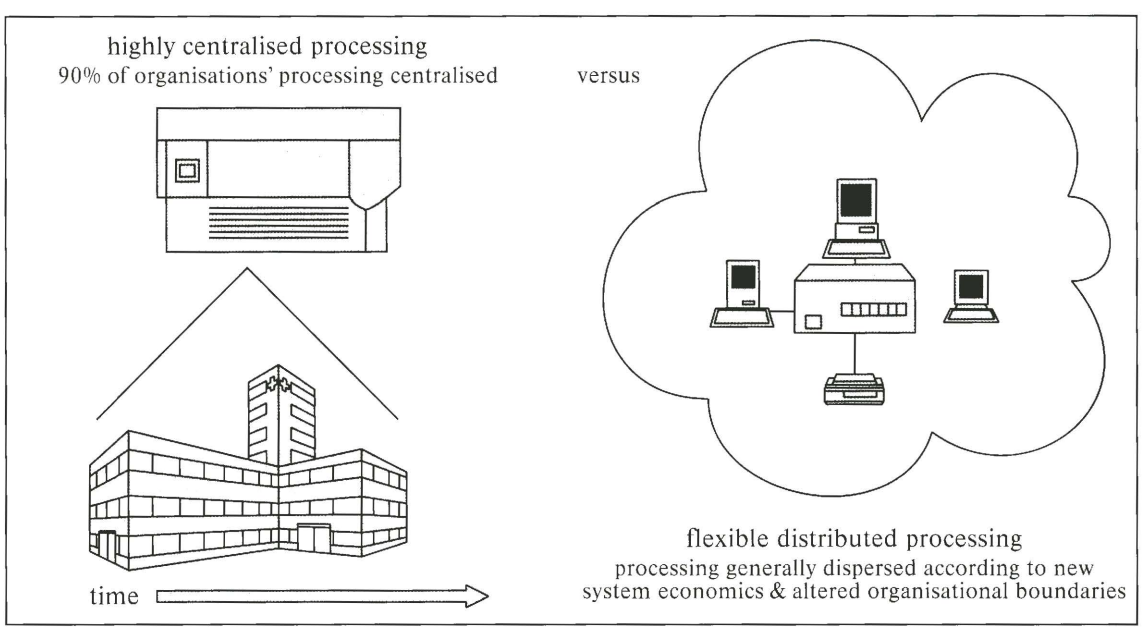


Figure 6
The Move towards Decentralised Processing

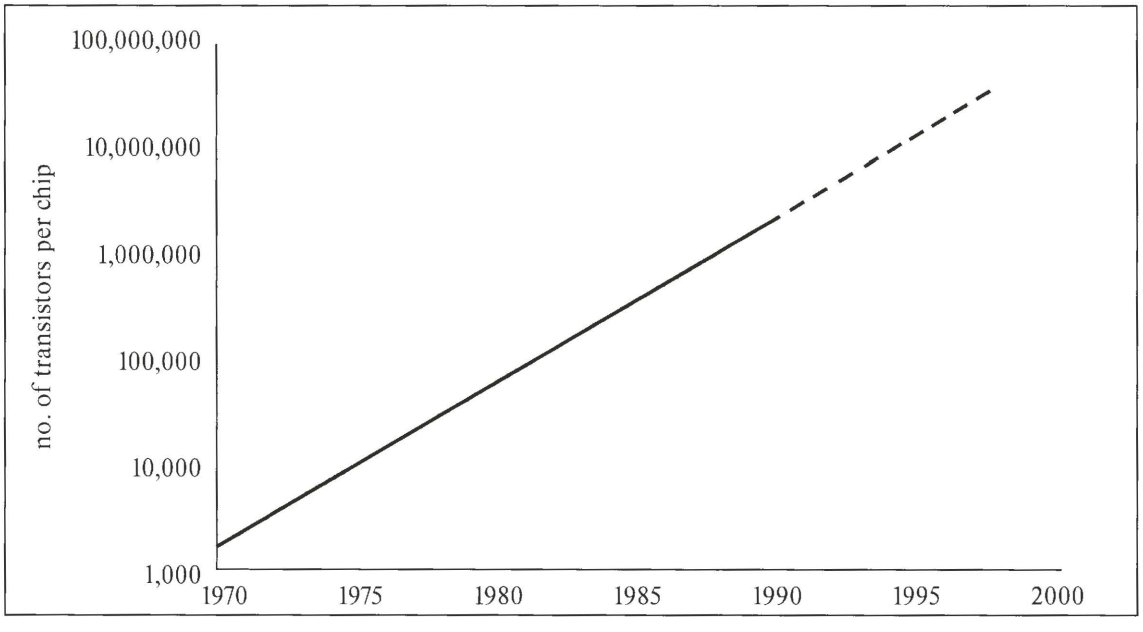
The development of the microprocessor has enabled the process described above. The differential rate of improvement in the price performance of the microprocessor relative to the increase in data transmission rates (at a particular cost) has determined the shape of the current style of devolved processing.

Looking back at the development of the underlying processor and memory technologies, the clearest way of describing the astonishing rates of development is by reference to the predictions of Moore, back in the 1960s. Moore's Law predicted that the number of transistors per chip would increase by a factor of two every year. This is illustrated in *figure 7*. The basis for the continuous improvement illustrated is the advancing capacity of silicon planar technology to increase the number of circuits per chip, the number of chips per wafer, and the number of functions per chip, by effecting order of magnitude reductions in device dimensions. Relay and vacuum technologies (the technologies of the 1940s and 50s) have gradually given way to the discrete transistor, small and medium scale integrated circuits (SSI/MSI) and large and very large scale integrated circuits (LSI/VLSI).

The improvements in computer technology made over the years are not limited to the field of microelectronics alone. For example, operating systems have followed a similar evolutionary path. Early batch processing techniques have been augmented by the techniques introduced with later multiprogramming, timesharing, and multiprocessing operating systems.

As technologies have advanced, the mainstream use to which computers have been addressed by users has also progressed. Although the many computers today are still used to perform data processing tasks, an increased use of computers to process information is detectable; as is the gradual adoption of knowledge processing techniques.

Figure 7
Moore's Law – Predicted Transistor Budgets



Price Trends

Recently, the state of the computing technologies, and most importantly the market supply and production infrastructures as well, has reached a level which has resulted in a reduction of the barriers to entry to such a level that the PC market has been pitched headlong into a vicious price war. The results of high and sometimes desperate levels of competition have included sharp reductions in the street price of PCs, both in Europe and the US.

This is illustrated in *tables 93* and *94* and in *figures 8* and *9*. More recently, changes in pricing policies by certain vendors in the Japanese

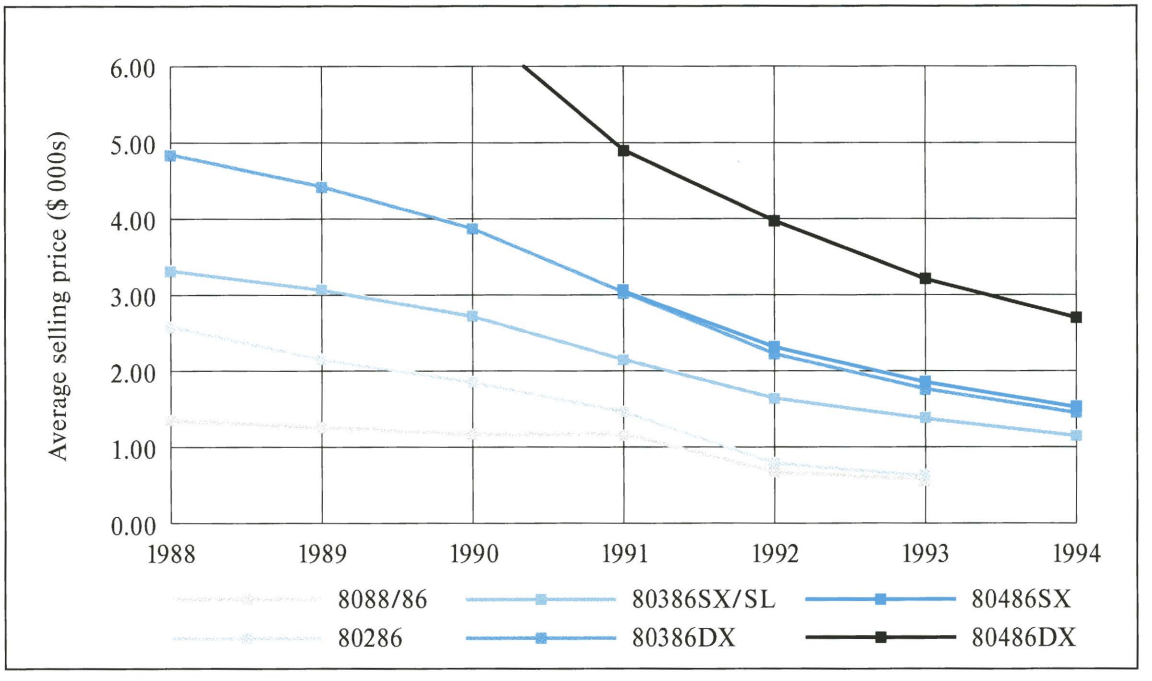


Figure 8
Evolution of US Average Selling Price for PCs

Table 93
Evolution of US Average Selling Price for PCs

	1988	1989	1990	1991	1992	1993	1994
8088/86	1,350	1,260	1,180	1,180	680	570	N/A
80286	2,600	2,160	1,860	1,470	800	640	N/A
80386SX/SL	3,330	3,070	2,730	2,166	1,660	1,380	1,160
80386DX	4,850	4,430	3,880	3,050	2,230	1,780	1,460
80486SX	N/A	N/A	N/A	3,060	2,320	1,860	1,540
80486DX	N/A	20,250	6,550	4,900	3,970	3,210	2,700
P5	N/A	N/A	N/A	N/A	N/A	7,250	5,220

DOS PC sector suggest that a similar process may soon gather pace in the hitherto insulated proprietary dominated Japanese market.

The recent experience of the PC industry gives a very demonstrable and extreme example of the dynamics of pricing in the computer hardware business. Although it is less obvious to the public gaze, many mainframe suppliers have also seen the prices they can charge undermined by recent market conditions.

The situation in the PC market is interesting, for it combines a number of factors including technological progress, architectural trends, global competition and the regional variation of

Figure 9 Evolution of European Average Selling Price for PCs

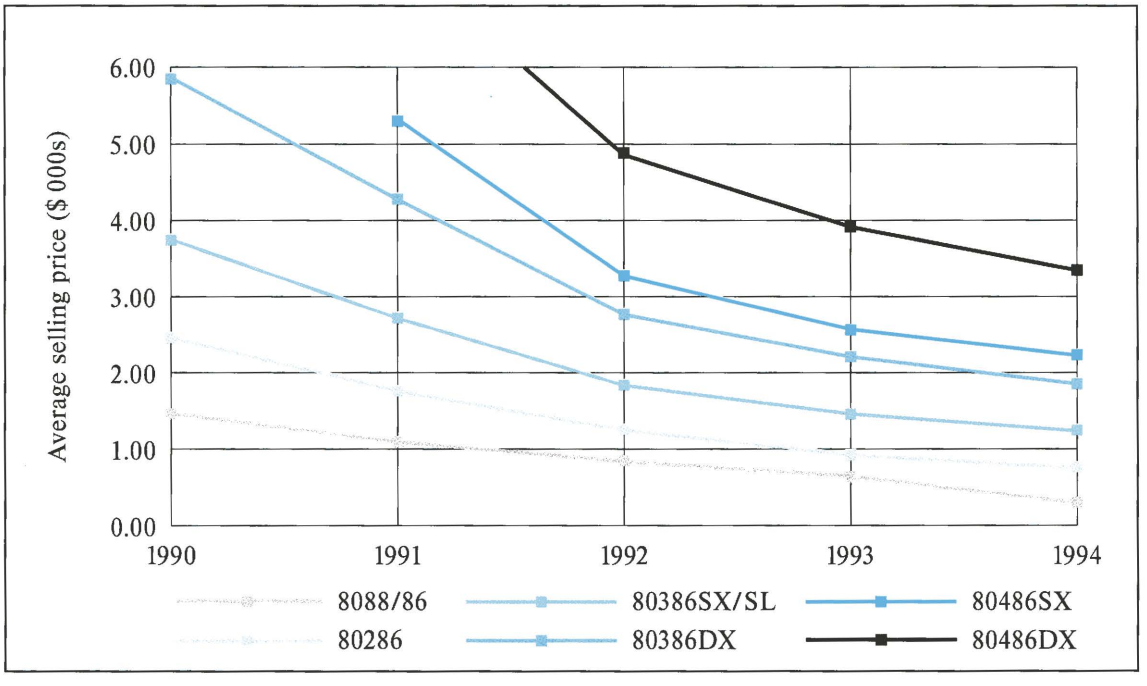


Table 94 Evolution of European Average Selling Price for PCs

	1990	1991	1992	1993	1994
8088/86	1,480	1,100	840	650	310
80286	2,480	1,780	1,270	930	770
80386SX/SL	3,760	2,730	1,850	1,480	1,250
80386DX	5,870	4,280	2,780	2,220	1,860
80486SX	N/A	5,330	3,280	2,580	2,230
80486DX	10,600	7,440	4,860	3,910	3,350
P5	N/A	N/A	N/A	11,570	8,930

prices. To illustrate the last point, the emergence of new modes of international business has raised particular problems for vendors selling to large accounts where the final destination of the goods may well be a country with significantly different local prices.

The price wars so keenly fought in the European PC market over the last two years have seen a dramatic levelling of prices between individual EC and EFTA countries and at the same time a considerable narrowing of the gap between prices in the US and Europe (illustrated in *figure 10).*

On the wider subject of price performance, *figure 11* depicts a generalised view of the evolution of the "price" per unit performance. Whilst it must be acknowledged that the precise nature of both elements of any such equation is difficult to agree and to measure, and that this view of price performance is too simple to describe fully the relative advantages of different types of platform and their underlying technologies, since it fails to take account of differing capabilities in terms of reliability, data security and manageability, it is possible to make some broad comments. Firstly, the slope of each curve indicates continuous improvement in price performance. This can be related to the improvement in component densities summarised by Moore's law, as well as a wide range of additional technological developments in the systems area. The differing slope characteristics point in turn to different sets of physical problems which form the limiting factors on the particular technology.

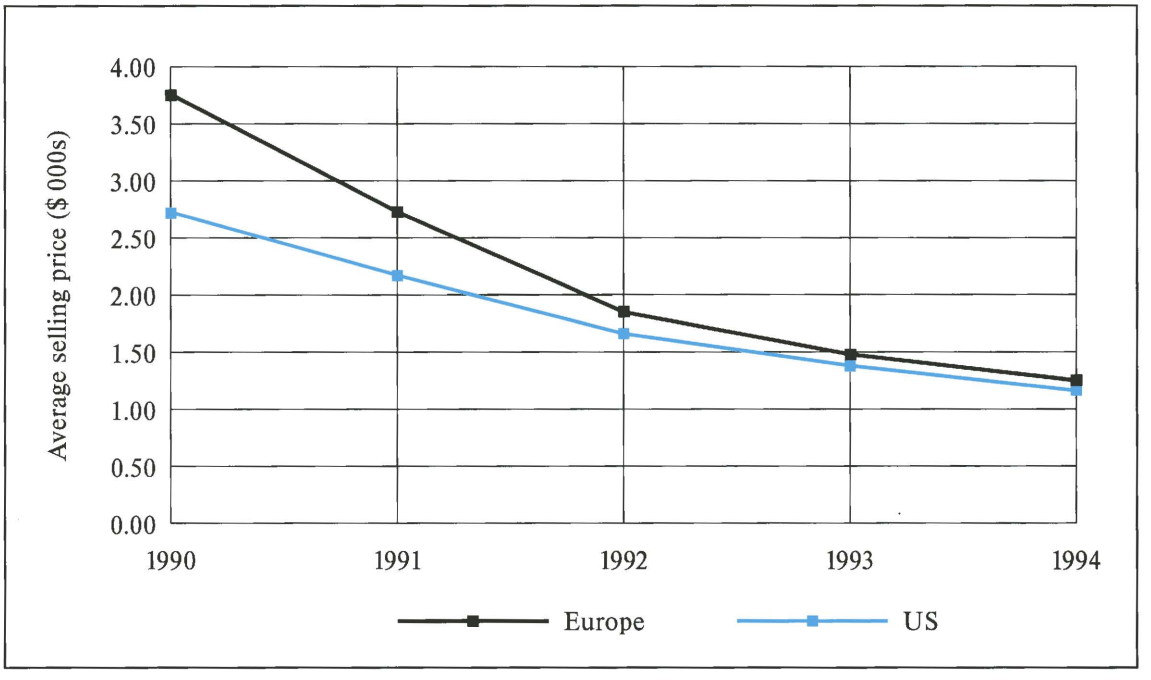


Figure 10
Convergence of 80386SX Average Selling Price (US versus European)

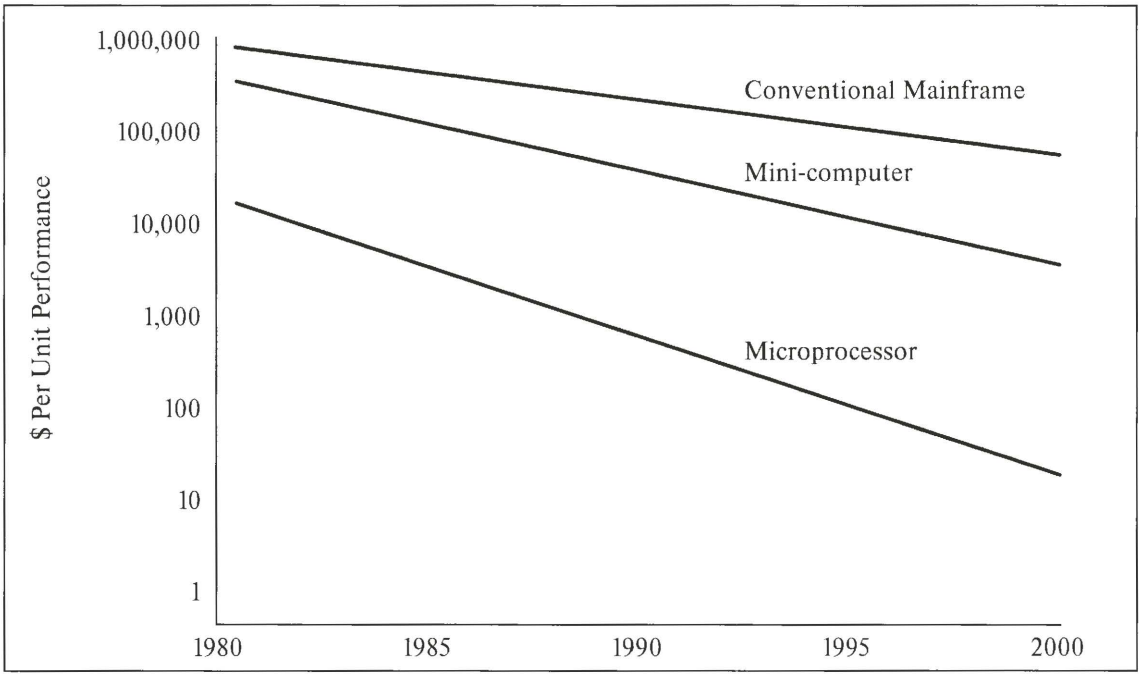


Figure 11 Generalised Processor Cost per Unit Performance (Development by Major Platform Type)

There is however, a more profound interpretation of this chart. Namely, that many of the architectural design considerations which influenced the design of a broad category of the IT products available today have been radically altered by the changing economics of the electronics industry. To illustrate, in the 1960s the very high costs of processing, storage and print facilities strongly favoured a centralised systems structure, in which a high degree of control can be exercised in order to maximise the use of capital intensive functions. The availability of cheaper processing, storage and printing elements, symbolised by the divergence of the cost performance curves, strongly favours a less centralised approach to systems design, which at the same time can exploit cheaper "intelligence" to improve the user friendliness of systems.

End-user Markets

The functions performed by IT systems throughout the World are often generalised as being either customised or standard, or as belonging to a family of horizontal or vertical applications. The dividing line between what is standard and not, and the manner in which such distinctions vary between different sectors of the economy is illustrated in *tables 95* to *97*. The split between internally and externally developed custom applications and packaged applications is given for a period of five years, ending in 1992, for a number of sectors of the economy in Germany, France and the UK.

The tables illustrate well the national and sectoral variation that is a feature of so many aspects of Europe's national IT markets. As well as confirming the extent to which customised solutions have been developed internally or externally, the most recent data show that there is some evidence of a modest switch in favour of external development of custom packages in some sectors and some regions. At the same time, data from the French market show an opposite trend in some notable sectors, such as retail, wholesale and manufacturing.

Tables 98 and *99* illustrate a broader picture, for Germany and the UK. 1991 IT spending on a variety of items in a nominal IT budget is shown. A feature not considered elsewhere within the statistical section is the significant extent of expenditure on personnel. The percentage of the total budget spent on IS personnel is given for a variety of sectors of the economy.

France	past five years			most recent year		
Industry sector	custom internal	custom external	packaged	custom internal	custom external	packaged
Finance	67.7	20.3	8.4	66.6	22.9	6.2
Manufacturing - industrial equipment	44.7	26.8	28.4	45.4	30.6	23.9
Manufacturing - other durables	66.9	13.9	15.4	75.5	11.9	8.9
Manufacturing - non-durables	82.2	9.2	7.9	83.7	9.4	6.9
Government	55.9	24.0	20.0	54.8	23.7	21.4
Business services	69.9	7.8	21.4	67.7	11.7	20.6
Miscellaneous services	64.5	23.5	11.3	65.3	23.5	10.5
Transport/Communications/Utilities	61.2	24.0	12.3	59.8	25.7	12.0
Retail	76.7	8.6	14.8	81.2	13.9	4.9
Wholesale	69.8	25.3	4.2	89.9	4.4	5.1
Other	74.5	12.1	13.5	73.9	12.6	13.4
Budget weight	65.4	18.5	14.2	65.8	19.9	12.3

Table 95
France
Internal/External
Expenditure
on Standard/Custom
Software -
% Historical
Allocation

Table 96
Germany
Internal/External Expenditure on Standard/Custom Software - % Historical Allocation

Germany	past five years			most recent year		
Industry sector	custom internal	custom external	packaged	custom internal	custom external	packaged
Finance	64.7	16.8	18.5	62.5	19.0	18.5
Manufacturing - industrial equipment	46.6	13.9	39.4	44.2	16.7	39.0
Manufacturing - other durables	37.3	13.5	49.2	37.2	13.3	49.5
Manufacturing - non-durables	35.6	18.2	46.2	33.9	18.3	47.7
Government/education	30.7	19.8	49.5	30.6	19.8	49.6
Business services	54.8	32.4	12.8	55.0	31.8	13.2
Miscellaneous services	25.1	16.9	57.9	25.1	13.8	61.1
Transport/Communications/Utilities	47.9	7.1	44.9	43.5	8.9	47.6
Retail	42.2	15.7	42.1	43.1	15.4	41.5
Wholesale	73.2	90.0	17.8	75.0	7.1	17.8
Other	45.9	25.5	28.5	42.0	27.5	30.5
Budget weight	51.1	17.9	31.0	49.6	19.0	31.4

Table 97
UK
Internal/External Expenditure on Standard/Custom Software - % Historical Allocation

UK	past five years			most recent year		
Industry sector	custom internal	custom external	packaged	custom internal	custom external	packaged
Finance	72.3	10.0	17.7	69.2	12.1	18.6
Manufacturing - industrial equipment	64.7	10.6	24.3	63.5	10.1	25.9
Manufacturing - other durables	58.1	8.5	32.8	61.4	7.8	30.8
Manufacturing - non-durables	48.2	12.1	39.7	48.3	10.9	40.8
Government	57.5	11.1	31.4	56.6	11.6	31.8
Business services	64.5	20.3	15.2	64.9	20.3	14.8
Miscellaneous services	53.2	6.9	39.9	52.0	6.7	41.3
Transport/Communications/Utilities	67.5	10.7	21.8	67.2	7.3	25.5
Retail	71.0	15.8	13.2	71.2	14.5	14.3
Wholesale	56.3	24.7	19.0	49.5	26.4	24.0
Other	62.4	12.2	25.4	59.9	13.9	26.2
Budget weight	63.3	12.3	24.4	62.0	12.5	25.5

Germany	Staff costs	Multi-user systems & peripherals	PCs Workstations Servers	Packaged Software	Services	Network Hardware Services	Other
Industry sector							
Finance	37.3	30.1	9.5	12.2	5.7	3.1	2.0
Manufacturing - industrial equipment	22.9	26.3	13.5	14.0	10.7	8.7	3.9
Manufacturing - other durables	31.0	27.3	12.5	10.0	7.1	8.1	4.2
Manufacturing - non-durables	30.6	30.8	10.8	15.4	6.5	3.9	1.9
Government/education	37.1	24.5	14.4	9.7	4.4	9.2	0.7
Business services	39.2	19.5	10.0	11.0	8.4	6.4	5.4
Miscellaneous services	17.1	17.4	37.2	12.8	9.8	4.6	1.1
Transport/Communications/Utilities	33.1	24.5	10.0	13.4	8.0	6.1	4.9
Retail	16.0	20.6	4.9	22.0	28.0	5.8	2.8
Wholesale	15.2	44.5	8.5	14.9	9.1	4.5	3.2
Other	30.6	25.9	24.2	6.1	5.3	3.2	4.7
Total	28.8	27.3	12.8	12.9	8.4	6.4	3.3

Table 98
Germany
Proportions of IT Expenditure by Line Item (in %)

UK	Staff costs	Multi-user systems & peripherals	PCs Workstations Servers	Packaged Software	Services	Network Hardware Services	Other
Industry sector							
Finance	30.4	24.3	12.5	8.6	11.2	8.3	4.8
Manufacturing - industrial equipment	27.5	24.2	13.2	12.0	12.7	5.6	4.9
Manufacturing - other durables	26.1	24.6	12.5	12.8	13.8	6.8	3.4
Manufacturing - non-durables	26.9	16.6	11.2	12.3	15.8	9.9	7.2
Government	31.4	21.7	12.6	13.9	10.2	6.9	3.2
Business services	24.5	29.8	14.5	6.4	13.8	8.4	2.6
Miscellaneous services	21.3	17.9	16.6	15.5	13.4	9.2	6.2
Transport/Communications/Utilities	19.9	24.0	12.8	12.6	19.8	8.4	2.5
Retail	36.6	23.2	14.0	8.7	9.5	6.3	1.7
Wholesale	25.6	15.0	13.5	16.5	15.7	7.6	6.0
Other	25.0	22.7	13.8	13.4	11.8	8.7	4.6
Total	28.3	22.5	13.2	11.4	12.5	7.7	4.3

Table 99
UK
Proportions of IT Expenditure by Line Item (in %)

10. Definitions

The Statistical Section of the EITO is based upon a set of definitions and methodologies agreed between the EITO Task Force and IDC, and upon the European Community standards for trade statistics. These definitions are outlined below.

Information Technology

For the purposes of this study information technology refers to the combined industries of hardware for office machines, data processing equipment, data communications equipment, of software and services.

Information and Communications Technologies (ICT)

For the purposes of this study information and communications technologies refers to information technology plus telecommunications equipment and telecommunications services. Reference to this concept is made in Part One, The Current IT Situation and Perspectives in Europe.

All market values are in constant 1991 ECUs, therefore growth is expressed in local currencies (without the effects of changes in currency conversions). Trade data are reported in current ECU.

10.1. Domestic Markets

Domestic Market Value is the revenue paid to primary vendors for office machines, DP systems, software and/or services for sale into the distribution channels or to the final customer. For product-specific definitions, see other terms below.

Unit Shipments are the unit measure of hardware product sales by vendors to all distribution channels or to end-users. Units are counted as they leave suppliers and are not double-counted in the case of OEM relationships.

Units Installed represent the number of units installed at the end of the year in question, after shipments into the market and retirements from the installed base are taken into account.

10.1.1. Hardware

DP Systems include CPU(s) and basic peripherals (e.g., data storage devices, terminals, memory and peripherals), as well as revenue for new systems added to the installed base. Multiprocessor configurations are counted as single systems.

Multi-user systems group all large, medium and small scale systems (i. e., all computer systems except personal computers and single-user workstations).

- *Large scale systems* are either large general purpose or high speed scientific computers with average system values generally in excess of $ 1 million. Representative systems include IBM's 308X, 3090 and water cooled S/390 systems and their compatible and non-compatible competitors, as well as so called supercomputers. Currently shipping models in this category typically support over 128 users in a commercial environment.
- *Medium scale systems,* which include traditional supermini class computers and some systems classified by their vendors as small mainframes, generally have average system prices ranging from $ 100,00 to $ 1 million. Currently shipping models in this category typically support 33 to 128 users in a commercial environment. Representative systems in-

clude IBM's 43XXs, 9370s, air-cooled S/390s, System/38s and larger AS/400s, the upper ranges of Digital's VAX series (including all 8000s and 6000s) and their competitors.

- *Small scale systems* typically range from $ 10,000 to $ 100,000. Currently shipping models usually support 2 to 32 users in a commercial environment. Small scale systems are also commonly used in automation, control and commercial processing environments and increasingly as network servers. Representative systems include lower range VAX systems from Digital (including all non-workstation MicroVAXes); from IBM the Series/1, system/36, smaller AS/400 models and server/multi-user configurations of the RS/6000; and low end multi-user microprocessor-based systems from Altos, NCR, Siemens-Nixdorf, et al. Also included are high end commodity chip models specifically designed to function as multi-user systems, even if manufactured by vendors typically associated with the PC or workstation market (e.g., the Compaq Systempro or Sun Sparcserver).

Workstations: The category includes single-user workstations from the likes of Sun, Hewlett-Packard and Digital.

Personal Computers (PCs) are general purpose, single user, microprocessor based machines that are capable of supporting attached peripherals and can be programmed in a high level language. Board level products are excluded. For microprocessor based systems that can support more than one user, IDC bases the distinction between a small scale system and a personal computer on the system's most common configuration. If a system is designed as a server or is multi-microprocessor based, it is classified as a small scale system.

- *PCs - Professional markets* are general purpose personal computers purchased from company budgets (including the self-employed home sector) or for use in educational establishments.
- *PCs - Home Market* are general-purpose personal computers purchased from household budgets. These systems are increasingly being used for more serious applications than playing games which typified the first generation of home systems.

PC Printers include models designed to be attached to PCs, not sold with the systems. These include dot matrix printers, thermal/thermal transfer printers, non-impact page printers, ink-jet printers and colour printers.

Office Equipment

Typewriters: mechanical, electric and electronic typewriters; Calculating Machines: professional desktop, pocket and hand held models; Copiers: personal, digital, and colour copiers; Other office equipment: duplicating equipment (offsets, ink duplicators), cash registers and POS, document filing (microfilm, WORM optical disks), other products (franking, addressing, labelling machines, mail handling systems, etc.).

Data Communications Hardware

LAN hardware is restricted to the hardware required to link multi-user systems, PCs or workstations to a local area network; it does not include software (e.g., specialised network operation systems) or servers, which are counted in their respective software and system categories. For this project, LAN connections that come bundled with a system and/or integrated on the mother board (e. g., Ethernet in workstations) are excluded to avoid double counting with the value of systems shipments.

The LAN hardware category includes the following categories of equipment:

- *LAN interfaces,* of which IDC tracks three categories: PC network interface cards, workstation network interfaces and multi-user interfaces. Value is normally assigned on a per-node basis and includes both new networks and nodes shipped into existing LANs.
- *Intelligent LAN concentrators* for this project are hardware devices that act as central points for star wiring for the nodes attached to the LAN and additionally provide network management functionality over the physical layer.
- *Terminal servers* provide terminal connectivity to the LAN.
- *Internetwork equipment* includes bridges and routers. Bridges connect two networks, operate at level 2 (data link) of the International Standards Organisation (ISO) Open System Interconnection (OSI) model and are protocol-insensitive. Routers are devices that allow for multiple paths, providing two or more connections. They operate at Level 3 (network) of the ISO OSI model and are protocol-sensitive, which allows them to "intelligently" decide how to route data.

Other data communications hardware is for this project expressly limited to hardware and to the following categories, of which it will be the sum: modems, multiplexers, X.25 packet switching equipment, digital switching equipment, communications processors and channel extenders.

- *Modems* tracked by IDC are restricted to analogue and short haul modems, segmented into dial-up and leased line segments and by speed (14.4, 16.8-19.2, 1200, 4800 and 9600 bps); not counted are fibre optic, satellite, pocket, or broad band modems or digital-over-voice (DOV) products.
- *Multiplexers* are devices used to multiplex telecommunications circuits, using time-division and statistical time-division technology. IDC tracks seven market segments: time-division multiplexers, point to point T-1 TDMs, networking T-1 TDMs, T-3 multiplexers (aggregates of 28 DS-1 circuits), and statistical TDMs; not addressed are coaxial or frequency division multiplexers or digital access cross-connect systems.
- *Packet switching equipment* includes all packet switch nodes to route data packets via the most efficient available path and PADS (Packet assemblers/disassemblers) to convert asynchronous and/or synchronous data to the relevant protocol format (e. g., X.25).
- *Digital switching equipment* includes matrix switches (designed to provide local and remote patching, switching and diagnostic functions, typically installed in data processing centres with two or more front-end processors) and data PBXs used to connect terminals to computer ports (increasingly obsolescent due to competition from front-end processors and local area networks).
- *Communications processors* are specialised and customised data communication devices that serve as nodal points for communications between IBM compatible hosts and other nodes on a network. The classical communications processor was a front-end processor configured to function solely as the interface between an SNA host and a cluster controller attached to 3270 terminals or PCs emulating terminals. Alternatives include remote processors configured as nodes in an SNA network and gateway processors configured to translate and/or route network protocols between SNA and non-SNA nodes.
- *Cluster Controllers* are devices designed to control the I/O operations of a group of 3270-type devices, including displays and printers.

- *Channel extenders* are devices that extend the distance over which an I/O channel on a single IBM mainframe can communicate with an IBM compatible peripheral or another IBM mainframe.

10.1.2. Software

Software products are commercially available packaged programs for sale or lease from systems vendors and independent software vendors (ISVs), and does not include specially designed application software solutions added by turnkey systems houses to systems acquired from a hardware manufacturer or other third party. The primary IDC categories are systems software and utilities, application tools, and application solutions.

Also, for this project the software products category includes all revenue for packaged software, including fees partially earmarked for software maintenance, services and/or support.

- *Systems software and utilities* are software programs designed (1) to operate hardware through basic operating systems and programming languages, increase the efficiency of systems personnel through system performance measurement tools, improve the operating capabilities of the hardware system by routing the flow of data among machine units and handle data entry and delivery, or (2) to ensure program integrity through maintenance and security programs, convert programs from one language to another, organise data resources through sort/merge products and monitor machine usage. Major components today include operating systems and extensions (e. g., MVS/ESA) and data centre management software, especially automated operations programs. Proprietary operating systems bundled with the hardware in the systems price are typically counted in systems revenue.
- *Application tools* are programs that allow users to retrieve, organise, manage and manipulate data and databases. This group is divided into four sub-categories: data access/retrieval, data management, data manipulation and program design and development. It includes all database management system (DBMS) software; decision support and executive information system (EIS) programs; spreadsheet programs; front-end and back-end case tools; and emerging areas like co-operative processing and/or object management application development tools.
- *Application solutions* software includes programs designed to provide packaged software solutions for specific problems inherent in an industry or a business function. Such software can address "Cross-industry" functions (e. g., accounting, human resource management, payroll, project management or word processing and other office activities) or specific industry solutions for vertical markets (e. g., banking/financial, manufacturing, health care, oil and gas exploration, etc.).

10.1.3. Services

Professional services comprise procurements obtained on a customised or contractual basis for system and/or software development, systems design, integration, installation, related training/education, facilities management and consulting services for information technology (IT) purposes only (i. e., management consulting services are not included). The primary professional service activities can be classified into:

- pre-implementation services;
- implementation services;
- post-implementation services.

Pre-implementation Services: IT Consulting:

Planning Services: consists mainly of requirements analysis (tallying of inventory of software, hardware and personnel, as well as IT needs assessment: security, audit, resource audit, work flow analysis) and IT Strategy analysis (migration planning, architecture development).

Business Process Redesign: restructuring of the business and operational processes, organisational boundaries, and management systems of an organisation. It is a methodological approach to implementing fundamental organisational change, critically evaluating and possibly discarding timeworn and non essential procedures, and building new capabilities utilising the latest information technologies to achieve breakthroughs in business performance.

Implementation Activities:

Contract Programming mainly consists of contract programming services, in custom software design & development, (with associated documentation and testing services). Software customisation services, software re-engineering services and translation services, also make part of this category.

Staff Delegation covers the provision of manpower (body shopping) usually programming tasks.

Post Implementation Activities:

Education and Training: IT seminars, training, course work, training related to new systems and network installation, and continuing education classes in software packages and programming. Several types of training services are identified: analyst/programmer training, computer operations training, management training, and end-user training.

Systems and network operations management covers all areas known as Facilities Management, Outsourcing, etc., and is defined as all systems and network operations services which a company may hire for assistance. This encompasses the operations management of a data centre or private network control centre of a client end user. It includes the continuum of operations management options from management of the customer's human resources and systems on customer premises to information technology asset purchase and migration to the vendor's systems, and third party development and maintenance of mission critical applications.

Processing Services

Processing services comprises bureau type services which can be classified under two further sub-headings; problem solving and transaction processing. Problem solving covers the provision of charged time on systems providing access to computer software tools, models or applications. Transaction processing covers access to specific applications programmes with charges often based upon the number of transactions processed.

Network Services

Network services is defined as chargeable value-added services provided under the following sub-headings;

- managed network services;
- network processing services;
- network messaging services.

E-mail, EDI and value-added transport services are typical examples.

Hardware maintenance and support services comprise, for the purpose of this study, the repair or replacement of components of computer systems hardware (including data communications equipment, but not industry specific terminals

like ATMs) and other hardware services, namely: disaster recovery, site planning, installation and relocation. Maintenance revenue may be generated by on-site maintenance, time and materials, parts for self-maintenance and/or depot services, in each case on a service contract or non-contract basis. To avoid double-counting, for this project, support services specifically excludes all software support.

10.2. Performance Measures

10.2.1. Trade Statistics

All trade statistics are presented in current ECU and are based upon official European Community data. All conventions common in the presentation of such statistics have been observed. For a full treatment of this complex areas readers are referred to the publications of the Customs Cooperation Council and Eurostat. Data has been selected based upon standard sub-headings of the Combined Nomenclature as listed below.

Values of imports are generally stated at customs value or by reference to the concept of customs value (cif); exports are stated at the value of the goods at the place and time that they leave the statistical area of the exporting member state (fob). The focus of the following analysis is the European Community.

In reporting intra-EC trade it is usual to report the country of consignment as the source of the goods even where this differs from the country of origin. For extra-EC trade the source is generally reported as the country of origin.

10.2.2. List of Import/Export Codes Used to Value IT Hardware Trade

84.69	typewriters
84.70	calculators
84.71	DP equipment
84.72	"other" office equipment
84.73	parts for use with sub-headings 84.69-84.71
90.09	photocopiers
84.43.12	sheet fed office printers (limited sheet size)

Please note: descriptions have been abbreviated. Product codes have been stated to indicate the level at which data was collected for this exercise. Thus, 84.69 should be considered to include all lower sub-headings below 84.69. For category 84.43.12 the same applies. Readers interested in the full details of the trade classification are referred to the publications listed below.

References

1. Explanatory notes to the combined nomenclature of the European Community, pub. Office for the Official publications for the European Communities.
2. Explanatory notes to the CCC harmonised system nomenclature, pub. Customs Cooperation Council.

10.2.3. Production

Production values have been computed using the relationship;

production = market value + exports - imports

where market data is based upon IDC data, and trade data is based upon appropriately adjusted statistics.

For IT hardware this relationship is relatively straightforward to calculate, since data is readily available on both counts. For non-hardware items the lack of suitable trade data prevents a straightforward analysis. For these sectors, estimated trade/production relationships have been used to complete the analysis.

10.2.4. Industry Leader's Market Share

Market share statistics are based upon aggregations of IDC research, in order to illustrate structural issues within the market, whilst at the same time preserving confidentiality. For example, the figure reported for the leader's share of hardware market in a particular country is in fact an aggregate of the market shares of the individual leaders of each of the standard IDC hardware market sectors.

10.2.5. Industry Concentration

As for the industry leader's (sic) market share (see above), industry concentration is an aggregate market share statistic. In this case, the market positions of the top 10 vendors in each of IDC's primary categories are used to compute the degree of concentration.

10.2.6. Inflation

All forecasts and historical figures include inflation and are stated in terms of local currency growth.

10.2.7. Exchange Rates

All market data and forecasts are presented in constant 1991 exchange rates. The exchange rates used for EC and EFTA markets are based upon the averages of daily rates for the individual currencies on the Paris money markets, as reported by the OECD.

For Eastern European research the peculiarities of that region have in the past dictated that research be carried out in a different fashion to that used for an established EC or EFTA market. However, the improved stability of Polish, Czech and Hungarian currencies during 1991 has allowed for the introduction of simple translations based upon the local commercial exchange rates quoted below. A different treatment is still necessary for the former Soviet Union. In this case valuations continue to be made relative to a set of initial dollar values for equivalent Western machines. These reference values are then discounted by a variable amount which reflects the systems age. Finally, data is converted into ECU using the appropriate $/ECU exchange rate.

Table 100
ECU Exchange Rates

1991 ECU Exchange Rates
(Units per ECU)

Austria	14.44
Belgium	42.27
Denmark	7.92
Finland	5.01
France	6.98
Germany	2.05
Greece	225.04
Ireland	0.77
Italy	1,535.25
Netherlands	2.31
Norway	8.02
Portugal	178.43
Spain	128.67
Sweden	7.48
Switzerland	1.78
UK	0.70
Japan	166.10
USA	1.23
Source: OECD	
Former Czechoslovakia	36.4
Hungary	86.4
Poland	13,827.7
Former Soviet Union	2.2
Local commercial rates	

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