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ENTERPRISE-TO-ENTERPRISE CO-OPERATION IN THE FIELD OF INFORMATION AND COMMUNICATION TECHNOLOGY *

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C O N T E N T S

INTRODUCTION

The area of international industrial co-operation, as well as the international enterprise-to-enterprise co-operation, is subject to many limitations. Furthermore, the future will see, as the past did, continuing attempts to block, make difficult, and channelize this type of international activities. Well known are the acts passed by governments in order to control the transborder flow of data and information, to protect declining industry, and to promote leading competitive industries. But, today's technological changes and general trends in technological changes for six main areas: energy, new materials, computers, telecommunications, aerospace and aviation, and biotechnology, will provide new opportunities for international relations and co-operation. These opportunities will bring to developing countries and their enterprises new possibilities and new background for their own activities and proposals for co-operation.

Development and application of new technologies have a fundamental importance for the economic growth and changes. Quickness and efficiency with which an enterprise can apply new technologies and use foreign technological achievements determines its long-term competitive capability. Dynamics of these processes all over the world, different forms of organization and co-operation on the international scene, used to try to advance the competitive capability and to make strong and stable the development of societies and associations involved (e.g. processes within the EEC), lead to increasing concerns, especially in developed countries, for a more balanced economic development (including the environmental protection aspects). This in turn heightens the awareness of a strong international and global interlocking of economic development, and offers some optimistic notions and possible plans for co-operation between enterprises in developed and developing countries.

This document aims at providing the "Ad-hoc Expert Group Meeting on Co-operation between Industrial Enterprises from Developed and Developing Countries" with a background paper dealing with "Enterprise-to-Enterprise Co-operation in the Field of Information and Communications Technology".

The aim of this material is to point out some aspects and areas of possible co-operation in the field of information and communications technologies, with special attention paid to a new, powerful industry with high annual growth and good prospects for the future - the software industry. One should stress that the opportunities and challenges of this industry arise from whole up-to-date and predictable future development of all sectors of human activity, and that it might assume different organizational forms. Nolan's assertion: "It is only the limitation in human will and creative imagination that restricts the extent to which the applications of this technology can support economic, social and personal development" is perhaps best suited to the software production sector, and to the whole area of information and communications technologies.

1. THE ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN INDUSTRIAL DEVELOPMENT AND INTERNATIONAL CO-OPERATION

1.1. A general survey

Information has undoubtedly become one of today's key resources. Like matter and energy, it influences almost all aspects of human life and work. But, unlike matter and energy, it is a resource not consumed by usage or lessened by distribution. When used, knowledge and information not only do not get consumed, they build themselves up and complement each other through communications. Furthermore, modern technological advances lead to significant quality jumps, to computerization with all the properties of a new industrial and social evolution, and revolution as well. At the core of technological quality jumps, there is a powerful and dynamic development of science. At the same time, human activities (such as education, manufacture, management, informing, decision making, and control) which were separate traditionally, join together, which indicates the integrative character of modern scientific and technological contributions based on the influence of infotechnologies.*

In this context developed countries may be defined as countries abounding in information, knowledge and technologies, while developing countries suffer their lack. Extreme concentration of knowledge has become one of the key problems of the modern world. The OECD and COMECON countries concentrate 95% of scientific research, development, and information equipment, and 95% of all patents. The OECD countries invest about 2.5 to 3.9% of their national product in scientific research and development. It has been proved that 1 USD invested in scientific research returns 12 USD on the average within 10 years, while 1 USD invested in development of infotechnologies returns 30 USD on the average within 10 years, which illustrates the profitability of investing into these sectors. But both in science and in infotechnologies the effects are achieved only when a critical quantity of investments is reached, together with the corresponding critical mass of personnel, suitable equipment, and a favourable business and development environment.

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* *The term infotechnologies here dominantly covers information and communications technologies*

Developed countries are entering the developmental phase called the "information society". Their economies are based increasingly more often on renewable resources (knowledge and information, biological sources, solar energy) and so-called high technologies consuming small quantities of energy and practically unlimited resources. The information society solves the problems of a standstill in development of industrial production by introducing robots, computers, and by development of science and education. Computerization of industry gradually introduces new, unsurmised prospects for growth and development of industrial production. E.g., in USA it is estimated that by the beginning of the new decade more than 30% of all jobs will be directly tied to computers, and about 90% of routine production processes will be controlled by a computer.

The turbulent development of microprocessors, based on increasingly fast and sophisticated manufacturing technology, offers new and challenging opportunities to constructors of microprocessor applications. Therefore the penetration of microprocessors and microcomputers into many industrial branches and products is undergoing a constant expansion. Industrial production is more often supported by computers by means of efficient discretely distributed intelligence or intelligence distributed within computer networks, with the tendency towards computer integrated manufacturing (CIM). On the other hand, the potential of "number crunchers" and communications systems is increasing rapidly, which makes it possible to realize ever more complex concepts of managing industrial, business, and social systems as a whole. This has become a strong incentive for new and faster technological changes and new forms and aspects of competition on the international market. However, this feedback has a very definite limitation - the market of ideas and the realizers of new infotechnology application concepts. This market is primarily based on personnel with increasingly higher education, whose lack is already felt, and will be felt even more strongly in future. Studies and research carried out in leading industrial countries indicate this aspect as one of the most dominant ones in future development. This fact is essential in defining the opportunities, schemes and models of co-operation between enterprises in developed and developing countries.

1.2. The infrastructurcl aspect of infotechnology

1.2.1. Direct influence of infotechnology on industrial development

Infotechnology has played a leading role in industrial development and development of other sectors. Introduction of modern information and communications technologies has revolutionized industrial and manufacturing processes. The higher the number of automated forms of manufacture, the lower the necessary input of manual labour and materials, and the higher the input of information and knowledge. The final product, be it a car, a TV-set, or a computer, contains much more information and knowledge than before, and the new product generations are superior to previous ones. Many firms have greatly increased the input of infotechnology into development of new products. E.g. out of 5 billion USD a big car producer plans to spend on highly integrated manufacture and prefabricated buildings for production of a new, innovated, small car, 40% will be spent for hardware and software. Use of computers in special applications within industrial firms continues to show a strong trend upwards, which is a consequence of development of microelectronics and the resulting reduction in prices of microcomputers on the market. Isolated "islands" of computer usage are still frequently encountered, but the rapid development of communication link software has made it possible to efficiently integrate computer applications into an integrated system. Development of computer programs for specialized computer applications in industrial production resulted in availability of a series of so-called CA techniques, or "computer-aided" applications. Figure 1 lists the most frequent abbreviations in the "computer-aided" field, and illustrates their distribution and variety.

Abbreviation	Name	Explanation
CAE	Computer-aided engineering	Basic term for computer applications in pre-production areas.
CAD	Computer-aided design	Design and calculation of product construction.
CAM	Computer-aided manufacturing	Planning and execution of production with computer assistance.
CIM	Computer-integrated manufacturing	Basic term for computer applications in all the technical areas of an enterprise
CAP	Computer-aided planning	Planning in the technical area of an enterprise.
CAPP	Computer-aided production planning	Planning and handling of production.
CAT	Computer-aided testing	Execution of technical tests with computer applications (e.g. new products).
CAQ	Computer-aided quality assurance	Product quality control and assurance.
CAR	Computer-aided robotics	Computer handling of production robots.
CAA	Computer-aided assembly	Assembly assisted by computers.

Figure 1. Abbreviations and explanations for CA techniques

Furthermore, beside office automation, computer integrated manufacturing (CIM) will play a major role in future. The most significant developmental activities in the field of infotechnology in the last several years include integration of commercial data processing, text processing, engineering data processing (computer-aided design - CAD, computer-aided manufacturing - CAM, computer-aided engineering - CAE), process control and telecommunications. Consequently, different information islands within the firm get linked together into computer integrated manufacturing of the third or fourth generation. All information units of order entry, product design, analysis

and simulation, process control, quality assurance, material handling, assembly inspection, test, inventory control, and shipping, are handled by the same data base. Figure 2 presents a survey of CA interrelations and visualizes the CIM process.

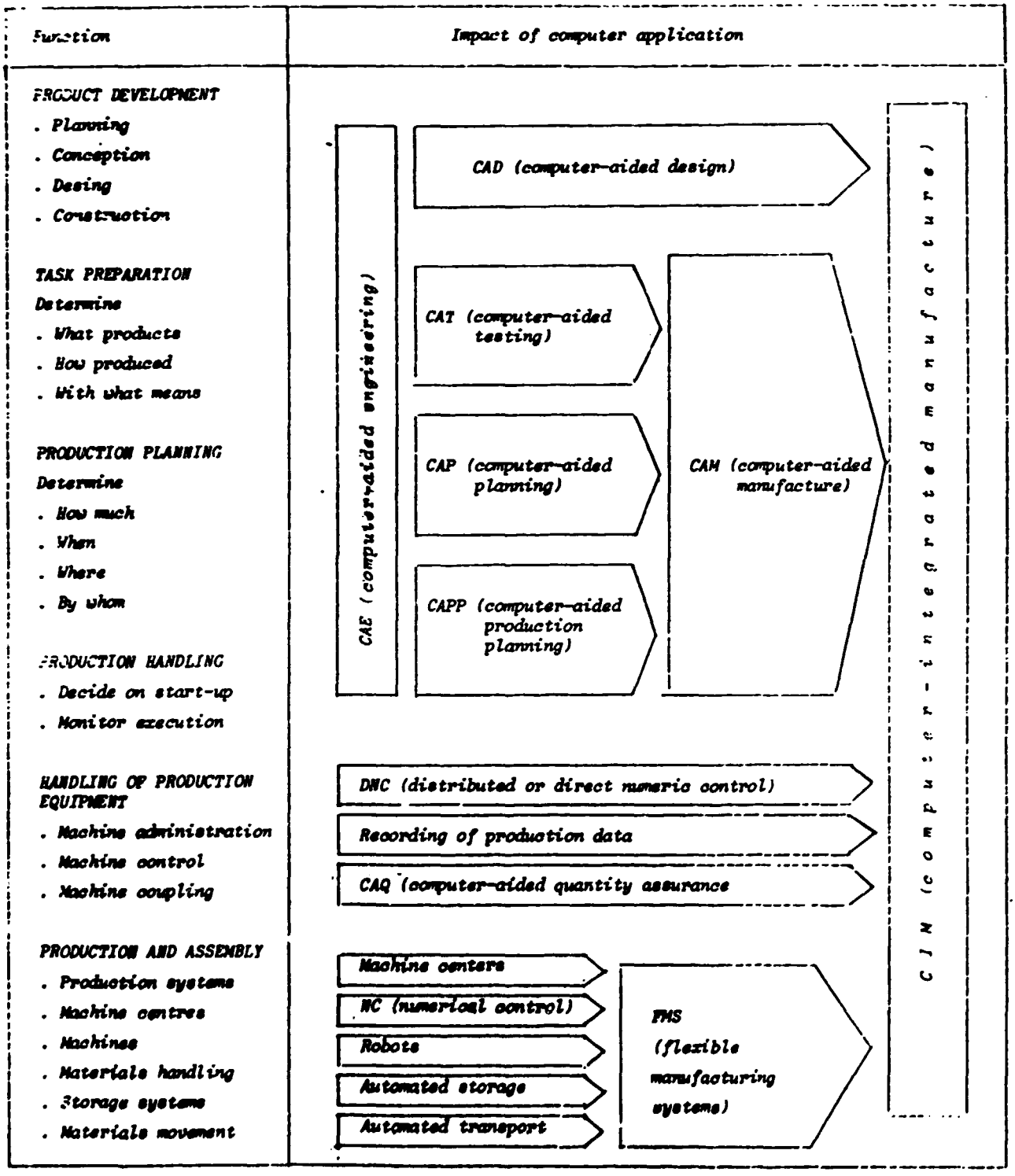

Figure 2. CIM structure

New computer and communication technologies have also provided for new opportunities and forms of trade, making it possible to perform many trade transactions electronically. E.g. in the services sector, many services have become available electronically (data processing, computer programming, video and audio entertainment, publishing, training and education, legal services, accounting, engineering, banking, insurance, research and development, advertizing and public relations, and communication and information services). The services trade is estimated to total over 600 billion USD annually, due to infotechnology.

According to an analysis made by the Organization for Economic Co-operation and Development (OECD), based on the data on 200 international manufacturing and services firms from ten countries, the following production functions are based on infotechnologies:

- *production control, illustrated by the growth of robotics and computer-aided manufacturing;*
- *research, especially for coordination of functions among research divisions;*
- *design/engineering with computer-aided design;*
- *marketing, especially for transmitting information about local conditions, enabling direct ordering arrangement for credit;*
- *distribution, including scheduling, routing and producing required transport or export documentation;*
- *order processing, to tie together interdependent production facilities and eliminate duplication;*
- *maintenance, such as to track after-sales defects and maintenance histories and provide useful information to product designers.*

Furthermore, efforts are being made to improve the internal processes of enterprise management through centralization of some management support functions. According to OECD, the most important are financial reporting and consolidation, financial management, data processing, and administration/clerical work.

Trends evident in the microelectronics sector (price reduction, capacity and speed increase, reliability gain, etc.) promote increasingly wider application of infotechnologies.

In this context, powerful development of communications technology and communication sector has created new support to research and development, manufacture, new products maintenance, introduction and marketing of new services required by the industry and by the economic and other sectors. Application of modern communication technologies has made it possible to introduce potent communication and telematic services, at the same time making the trade in information-based services a viable economic activity. Usage of communication technology has led to creation of new products and services, which increased the opportunities for international trade and globalization of market activity in many enterprises, providing at the same time new opportunities for co-operation.

This made it possible for large international systems and corporations to achieve efficient management and bi-directional communication with the market, customers and co-operationists. This also led to organizing the inhouse information-based services (data processing, financial management etc.) as stand-alone profit centers by parent companies. A good example is provided by McDonell Douglas Corporation, a manufacturing firm which has developed a data base for its internal research and development activities, and which now includes a separate subsidiary providing on-line data services to public both in USA and in the world.

Many international companies own world-wide communication networks for coordination of their subsidiaries, and for gathering and dissemination of information. Such companies are able to make construction changes in all their manufacturing plants all over the world in the same day. Infotechnologies have made many things and jobs possible, practical, and efficient. E.g. they have revolutionized banking by making it possible to gather enormous quantities of financial data and to transfer money immediately. Similar things have been happening in other sectors.

Introduction of computer-to-computer communication technology (electronic data interchange - EDI) has changed traditional concepts of time and space. Satellite technology, fiber optic cable technology and other communication technologies provide for immediate information tranfer. Advances in this area make it possible to perform a service at one location and use it wherever and whenever one wants to.

1.2.2. Networks - support to activity globalization

Development and application of infotechnologies has led to new systems known as value-added communication networks, linking information providers and users. Through systems which include computers, communication circuits, and input-output terminals, people at various remote locations can input information into the network and retrieve information out of it.

Linking into networks was of essential significance to formation of ways the modern economies of developed countries function, and of ways the future international economy will function. According to some sources, networks are at the heart of the post-industrial revolution.

Electronic data interchange (EDI) - the direct computer-to-computer exchange of standard business documents such as invoices, bills of lading, and purchase orders, has changed the way enterprises do business. E.g. IBM's 37 world-wide plants will be doing EDI with more than 2000 of the company's larger suppliers by 1991. That represents 80% of IBM's production, which is a large part of the total computer industry production.

There are different network shapes, but they share the same character and purpose of information dissemination. Some networks are interactive, i.e. they allow access, addition of new data, or updating of data already stored. Others act as unidirectional information flows. There are three levels of networks. The first level networks are private international communication networks maintained by a number of multinational corporations for internal communication within the firm. The second level networks are those which were brought about by common interests of an industrial branch, where firms unite all over the world in order to develop industry-wide networks known as limited participation networks. Access is limited to the members of the network. Well-known second level networks are SITA (Société International de Telecommunications Aéronautique), SWIFT (Society for World-wide Interbank Financial Telecommunications), NETWORK of the World Trade Centers Association. The third level networks are public networks offering on-line approach to, as estimated, over 3000 data bases.

Communication networks, beside being crucial to development of their users, also provide a very effective means for promotion of international industrial co-operation. E.g. NETWORK, covering about 50 centers all over the world, has for its basic function the exchange of information on demand and supply in all sectors of industry and services in these countris, including demand and supply of programs, projects, products, capacity, co-operation, capital, etc. Messages transmitted through NETWORK are received by about 100,000 different end users worldvide, which increases the probability of finding possible partners for co-operation and choosing the most suitable one.

1.2.3. Application of infotechnologies as a measure of successfulness of an industrial enterprise

The degree of application of infotechnologies in any segment of industrial production is correlated to product quality, competence and competitive capability, and development potential of an industrial enterprise, and also to its openness, or its readiness to co-operate with others. One may say that infotechnologies are, besides being the basis for development of modern industrial enterprises, also the means for globalization of their activities.

A nice example is provided by the colorful Italian clothing company Benetton SPA, which has witnessed a growth from a simple door-to-door family operation up to a billion dollar multinational corporation within the period of twenty years. It has become an industry reference model exemplifying the competitive use of infotechnology. From the industrial viewpoint, Benetton's commercial success is due to a well planned and successful strategy of application of infotechnology. Today, Benetton is a group of companies with 44,000 trade points in 60 countries of the world. Production, distribution, design, communication with the market, trends tracking, etc., all are also based on infotechnology (from robots in the storehouse, through EDI networks to CAD in new models design, etc.). This group could not work any more without infotechnologies.

Another example may also indirectly indicate the link between success of a company and application of infotechnology. The recent studies at the University of Leuven in Belgium have revealed that executives in very successful companies may spend up to 75% of their time working with external data and information. The opposite holds true for unsuccessful companies, where executives spend up to 75% of their time working with internal data.

1.3. Manufacture of infotechnologies

The world's infotechnology industry has made approximately 300 billion USD in 1988. through production of mainframe, minicomputers, microcomputers, data communication equipment, peripherals, software, information services and maintenance. In 1987, 100 largest Asian, European and Northern American firms had the total production growth rate of 18.7% as compared to 1986; in 1988, the growth rate amounted to 16.3% as compared to the previous year. Regardless of a certain decrease in the sales growth rate, market fluctuations and their causes, this industry has proved its viability, and its one evident characteristic - the international nature of business. Namely, the infotechnology industry has been becoming increasingly global, partly due to market influences and currency fluctuations, and partly due to the technology itself. Ten biggest firms hold over a half of total information systems market (IBM, DIGITAL, UNISYS Corp., HEWLETT-PACKARD, and NCR from USA, FUJITSU, NEC Corp., and HITACHI Ltd from Japan, SIEMENS and OLIVETTI from Europe, with the GROUP BULL very close).

The growth witnessed by these world's giants in infotechnology has created concerns about possible destructive trade wars. However, if one analyzes the global competition aspect within the context of a trade war, a possibly important trend may be noticed - an increase in the level of global co-operation of today's biggest multinational corporations. Accordingly, what those companies are concerned about are small firms appearing on their home markets, companies developing improved products and winning precious market niches. According to Kenichi Ohmar of McKinsey & Co, whose book "Triad Power" describes the new style of global competition between USA, European and Japanese multinational companies: "There is a clear intention today that top management of global enterprises are seriously interested in protecting home market position and, if necessary, are willing to co-operate with other Triad region competitors rather than fight them off in destructive trade wars".

As has been the case so far, the main factor responsible for the two-digit annual growth rate in computer industry is the continued decrease in computing capacity prices. This dramatic price decrease has inspired new demand for

computer applications. However, there is no evident reason to expect the decrease in prices of storage devices and processors, and thus in computer prices, not to continue. This will create new markets and new opportunities for small firms setting out to win their niche on the market with their innovative products. The increased role of non-proprietary industrial standards suggests the need for easier entry onto the market, and for infotechnology industry to become more competitive.

What is important for our topic is the fact that one need not manufacture the whole system in order to appear in the infotechnological market, one need only do one's small part better than anybody else.

On the other hand, one should bear in mind huge investments in research and development made by all the leading companies in the field of infotechnology. E.g. these investments for 10 largest firms in 1988 range from 4.7% to 14.34% of their total revenue, or from 307.3 to 5925 million USD. This means that the product unit price may be decreased only if these costs can be spread over more than one market. This is one of the reasons why the infotechnology industry, as well as other research-intensive industries in the field of high technology appears on the international market, searching for the widest market possible. In this context, today more than ever, different forms of co-operation and partnership are attempted, so that there are co-operation models being realized which only a short time ago seemed improbable.

1.4. Some new trends in development of infotechnologies

Leading laboratories all over the world are pushing research toward brain-like computers - the sixth generation of computers. The sixth generation will offer the following machine categories: adaptive and learning systems, artificial neural systems, neural computers, adaptive goal-directed expert systems based on genetic mutation algorithms, event-train computers, transformation (mapping) systems, associative memories and processors, fuzzy and pseudo-associative systems, hypercubes, array-processors, programmable connection machines, concurrent systems including transputer family and OCCAM language, and computers in neurobiology and behaviour.

The infotechnology market is expected to be under the influence of those projecting and producing sixth generation equipment and systems, based on very large-scale and wafer-scale integration.

The aims of the sixth generation infotechnologies are truly intelligent computing, measurement, control, robot or information systems. Although brain-emulating computers cannot be expected to appear, one may expect emulation of many logical and intelligent functions of neural or behavioural systems. Research going on in this area is interdisciplinary, and includes computer science, engineering, physiology, linguistics, logic and psychology. This research generates new architectures, alogrithms, components, systems and applications. As a matter of fact, a new discipline is being born, the one called psychological/intelligent/neural/knowledge engineering (PINK engineering) by B. Souček.

Through equal treatment of biological and technological systems, this discipline improves the existing and creates new job profiles. To achieve market attractiveness, consumer goods and industrial equipment of all kinds will be wrapped in a PINK package including: natural interface to the user based on non-restricted dialogue, speech, and image; features of adaptibility, learning, sensing the environment; human-like behaviour, offering the user a new sensation of mind and body, new experiences and pleasures. As a result, it is estimated that this new discipline might become the basis for superindustrial and modern economies, which is borne out by high level sponsorship and coordination in some countries (Japan, Germany, etc.).

This discipline includes the following technologies:

- *intelligent-systems measurement and analysis,*
- *intelligent-systems modelling and simulation,*
- *intelligent-systems design and interfacing,*
- *intelligent-systems coding, programming, and training,*
- *intelligent-systems application.*

Figure 3 shows the sixth generation project data, and Figure 4 presents the project goals.

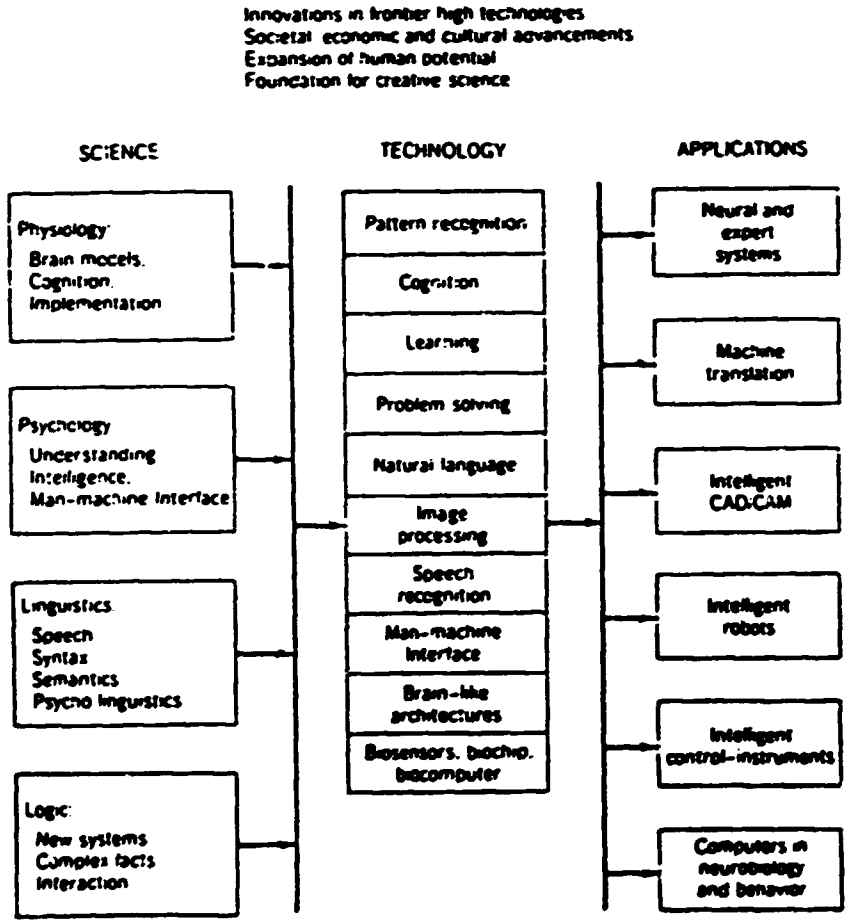

Figure 3. The sixth generation project

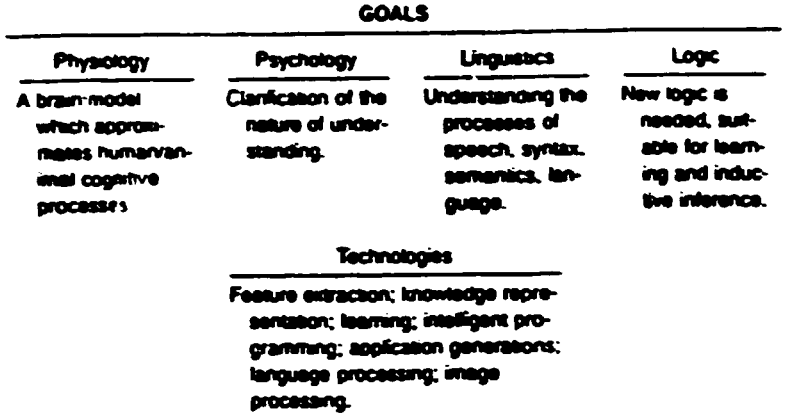

Figure 4. The sixth generation goals

It is very probable that infotechnologies based on the sixth generation computers will leave their mark on the decade to come, both due to attractiveness of their goals, and to the number of scientific and engineering fields included.

2. PREREQUISITES FOR ENTRPRISE-TO-ENTERPRISE CO-OPERATION IN THE INFOTECHNOLOGY SECTOR

The analysis of individual case histories of realized international industrial co-operation may lead to a definition of incentives and prerequisites for starting, realizing, and developing this co-operation, especially as regards industrial co-operation in the field of infotechnology between enterprises in developed and developing countries.

We shall start with aspects concerning interests of enterprises in developed countries. The basic interest such an enterprise wishes to realize through co-operation with an enterprise from a developed or developing country is the most favourable possible ratio of capital invested into product development, production and marketing, to financial effects achieved by placing the product on the market. In this context, enterprises from developed countries may find it in their interest to co-operate with enterprises from developing countries, especially if they will be able to achieve a favourable ratio of investment into product and manufacture to financial effects realized, by decreasing costs of manufacturing of their final products, and provided co-operation may be stretched to include sales on the market of the developing country involved.

However, it is a well known fact that enterprises in developed countries innovate their production, invest into research and development, and promote co-operation primarily in order to win the market of developed countries. This means that all organizational and technological changes and innovations actually represent their answer to or preparation for reqirements of markets in highly industrialized countries. On these markets it is possible to return, relatively successfully, the capital invested and to make a profit by means of appropriate price levels and offered quantity of new or innovated products, but only once competition has appeared on the market, and the price reduction has occurred, such products may be placed on markets of developing countries at possibly acceptable prices.

On the other hand, enterprises from developing countries, beside evident economic reasons, feel the need for co-operation in order to create channels for influx of new information, knowledge and technologies, for innovating their own production, and for possible structural changes, in hope that a better developed partner might make it possible for their products to be sold on other markets.

The technology transfer is the key aspect of these relations. The term technology connotes a whole area of knowledge about a product or a production process, and includes the technical skill necessary for product manufacture or process application. In industry it will cover product-design, production-techniques and related managerial systems. The technology transfer in its essence represents the transmission, revision (adaptation), and implementation (absorption) of such accumulated knowledge that is actually put to productive use. There are different channels, formal and informal, used for this transfer. Licencing and direct foreign investment are the two most frequently used technology transfer channels.

Technology is transferred abroad in different ways: in "raw" form as data, or contained in capital goods, in products, in systems and organizations, and in educated/trained minds. The extent of transfer also depends on the extent of trade, the extent of communications (especially in technical fields), the extent of foreign investment (especially by technologically advanced countries) and immigration of skilled personnel. The extent of transfer is increased by foreign technical journals, sponsoring university education at foreign universities and other centres of excellence, and joint ventures with firms from technologically developed countries.

There is another aspect important for our topic. Adapting the developed countries' technology to national applications is the essential prerequisite for development of innovative capability and environment as the base for creation of new technologies. Ability to accept and adapt a new idea easily is a prerequisite for ability to innovate, which means that every enterprise and every country which manages to do it possesses a high innovative potential. Such environments are often called innovative environments. Well known is the ability and skill Japan shows in adapting technology developed elsewhere, so quickly and efficiently that only a few years later the original innovator is no longer able to compete. Japanese success in development of its economy can be ascribed to its policy (MITI) of encouraging local adaption of imported

technology.

The vital component parts of innovation as a process seem to be the following: a perceived market demand, scientific knowledge, business and technical talent, a source of risk capital, a source of skilled and educated manpower, and a "reasonable" tax and regulatory environment.

Infotechnology, being a high technology, is a very demanding and sophisticated field as regards international industrial co-operation, which demands some prerequisites in order to achieve its goals, especially if one wants to pass from imitation to the innovative phase of infotechnology production, all seen from the point of view of the less developed partner in co-operation.

Tha basis for establishing and developing successful international industrial co-operation in the field of infotechnology through various forms of partnerships between developed and developing countries is actually a group of facts, measures, activities, processes and solutions which correlate to specific features of environment the enterprises are located in. Specific traits of some developing countries, different degrees of industrial and technological development, availability of research and development potential and investments, and different sociological, culturological and other aspects lead to different combinations of the group elements.

A series of studies and comparative analyses have defined prerequsites belived to represent the elementary initial group for promoting co-operation between enterprises from developed and developing countries in the field of infotechnology, and other high technologies as well:

- *availability of skilled and educated manpower;*
- *existence of a consistent and stimulating environmental infotechnology development policy, including innovation promotion;*
- *availability of stimulating financial sources and venture capital;*
- *a "resonable" tax and regulatory system,*
- *development and implementation of industrial ownership protection system;*
- *possibility for market expansion;*
- *sophisticated infrastructural facilities.*

Each of these prerequisites may be elaborated at some lenght. However, for our purpose, a concise commentary is provided below. As has been said, the greater the similarity of the levels of technological development reached, the more certain and extensive the international co-operation in the field of high technologies. So, our commentary will be given primarily from the aspect of realizing prerequisites making it possible for enterprises in developing countries to have successful co-operation with those from developed countries.

Many sources indicate the basic prerequisite for co-operation to be the existence of a critical mass of skilled and educated manpower within the enterprise or in its immediate surroundings. Personnel training through usual and special forms of education (universities, specialized training) is the essential prerequsite for launching international co-operation and obtaining favourable results. Requirements in the field of infotechnology, and happenings at the world infotechnological market ask for increasingly higher education of manpower that should be prepared for and capable of highly dynamic innovating their own knowledge. Many examples from developing countries (e.g. Bangalore, India) prove that successful co-operation of enterprises from developed and developing countries has been realized in environments with quality forms of education in the field of infotechnology, those with well developed scientific research and organizational teams in fields relevant to the field of infotechnology. Also, manpower trained in developed countries, besides accumulated knowlede and know-how, provide a sound basis for communication with enterprises from technologically more advanced countries.

Existence of a consistent and stimulating infotechnological development policy including innovation promotion in the country the enterprise is located in, is a stimulus for promotion of international co-operation. Firstly, the awareness of developmental and economic potential in infotechnological production results in a program of incentives, and secondly, in such environments prerequisites for new creation are realized, which gives a preferred status in international co-operation to enterprises located there. This policy also provides a basis for creatively and developmentally powerful manpower.

Availability of stimulating financial sources and venture capital is a desirable background making it easier to initiate development and promote concrete actions of enterprises from developing countries in mastering

infotechnological production and forming international co-operation programs. This prerequsite, together with the two previous ones, represents the basis for a country's own achievements in the infotechnological sector. It makes it possible to initiate a necessary and desirable mechanism: initial groups of business-wise and technically talented people, supported by locally available skilled and educated manpower, can realize very motivating business and developmental achievements, which provided, as it seems, the basis for the marked clustering phenomenon exemplified by the "Silicon Valley" in California and the "Route 128" research industrial corridor around Boston, Massachusetts, both in USA.

The requirements listed might provide a basis for a kernel of high quality research and development units and institutions in developing countries, which will gradually become surrounded by successful enterprises in the field of infotechnology, which will in turn increase the attractiveness of these environments and these enterprises in international co-operation with technologically more advanced partners from developed countries.

Existence of a "reasonable" tax and regulatory system, according to a number of authors in the field of economic sciences, is the key factor in regulation of economic development. It is as important for development of national economies as for attractiveness in the international industrial co-operation. The period after the Second World War provided very impressive examples of some tax and regulatory system models achieving very good results (Germany, Japan). Development processes in these countries were initiated only after a series of serious tax reforms. Many authors and examples prove that industrialization developed in environments with unhindered economic activities and low taxes. The examples mentioned recently include Hong Kong, Singapore, Taiwan, Republic of Korea, Brasil, etc. Furthermore, specialists in the area of development often indicate tax reforms to be the key elements of development strategy in developing countries, as shown by many studies made by the World Bank. Beside the tax aspect, a "reasonable" regulatory system (also including other fiscal and non-fiscal aspects) should enable the enterprises in developing countries to enjoy equal business conditions as enterprises from developed countries, and thus promote international co-operation. In such business conditions, the partners would start from equal positions, and realize their interests and possible mutual benefits in accordance with their investment,

which is particularly important for the partner from technologically less developed environment.

Protection of industrial and intellectual ownership is an aspect which must be borne in mind. If this prerequsite is realized, an atmosphere of security and confidence will be created as regards technological and other contributions, knowledge and know-how included into international co-operation, and partners' rights will be protected. A new GATT round (General Agreement on Tariffs and Trade) has paid due attention to this subject thereby proving its importance for international trade and co-operation, and for interests of partners and countries involved in these activities.

Market expansion is a prerequsite immanent to every market-oriented activity, and, if seen from the practical point of view, it is the basic motive for co-operation, regardless of the actual market involved. However, the interests of the partner from a developed country lie primarily in entering the free or insufficiently covered market of the partner from a developing country; the interests of the partner from a developing country lie in a possibly more certain coverage of its own market, possible entrance to the partner's market, and a chance to win third markets. Strategically speaking, this implies the increase in competitiveness of products resulting from co-operation on the whole international market. Only when this aspect of co-operation is realized in its entirety, will international co-operation of enterprises from developed and developing countries achieve its full meaning and the best effects for both parties.

Sophisticated infrastructural facilities include primarily technical and technological and organizational prerequsites such as availability of telecommunications and telematic systems and services, international transport and communications, business support, efficient local administration, etc. The importance of this prerequsite may be understood from a several years' old commentary on international co-operation in the field of infotechnology in Singapore, which states that the attractiveness of Singapore does not lie in the cost of its manpower, but in its highly developed infrastructural facilities.

International industrial co-operation in the field of infotechnology, as concerns its initiation, maintaining, and developing, does not differ from international co-operation in the field of other high technologies, although

it has its specific traits and benefits resulting from the very essence of the technology.

Our commentary has pointed out existing or possible limitations for each of these prerequsites, and possible solutions as well, all on a global level.

The prerequisites have not been ranked according to their "specific weight", or importance in attracting and maintaining international co-operation, but have been presented as a very probable group of necessary prerequisites providing the basis for international co-operation. However, it should be stressed once more that international co-operation is more easily initiated and developed between technologically or otherwise similar environments. This means that the role of a consistent and stimulating development policy in the field of info-technology precedes other incentives and prerequisites in creation of conditions for international co-operation. Existence of national high-quality info-technology development strategies in developing countries, suited to the local environment, is the conditio sine qua non for any long-term co-operation of enterprises from developed and developing countries. These strategies, correctly defined and founded, provide a powerful generator of other prerequisites for international co-operation, especially if these national strategies are not only a reaction, or a defensive answer, to fast technological changes and international strategies accepted by other countries and their enterprises directing and defining the changes. If these strategies can be and are initiati... they will become competitive and interesting for co-operation processes.

Co-operation aspects also have their importance in the area of national strategies. Namely, an almost unimaginable complexity and sophistication of relations of many factors affecting production in the field of infotechnology on the international market as regards creation of new products and market-winning strategies, lead to formation and development of different co-operation alliances of powerful partners from developed countries (e.g. ESPRIT in Europe), which makes it harder for independent successful breakthroughs of enterprises from less-developed countries or developing countries, and which indicates the need for very innovative approaches to forming the national strategies in developing countries. So, it seems desirable to form appropriate development alliances of partners from a number of developing countries, which might include

developed countris, too. In this context, the role of UNIDO is a crucial one - assisted by the World Bank and other banking and financial sources, including individual national contributions, it should directly support this type of activity. This type of international co-operation is especially desirable and almost necessary in the field of fundamental research. E.g. we shall mention the field of superconductors. Several Japanese firms and MITI formed their International Superconductivity and Technology Center (ISTEC) last year, directed towards and inviting international co-operation. AT&T, Emi Chem, IBM Europe, Montedison and Phillips have formed a new industrial consortium in Europe, the European Institute of Technology (EIT) on superconductivity as the first activity. In USA a research consortium is being planned, The Superchip Corporation, which will be founded by US industrial enterprises and probably supported by the government. These activities are supported by a powerful research infrastructure and potential, and by hundreds of millions USD. Therefore the statement by C.N.R. Rao of the Indian Institute of Science, based on 10 million USD obtained with difficulty for research in the field of superconductors in India, that developing countries "can never be equal" to the advanced nations, is very indicative, and invites international co-operation.

Furthermore, there are some additional prerequsites or aspects that either stimulate or limit co-operation. Together with other prerequisites, they define both models and achievements of international co-operation. They are, firstly, the ability of enterprises from developing countries, which have or plan to have production in the field of infotechnology, to generate their own quality programs of industrial co-operation, and the ability for efficient realization of that program, for choosing the appropriate partner and arranging the relationships in co-operation. In these activities the availability and support of high quality consulting firms seems to be important and desirable. This is evident with smaller firms having innovative and flexible manpower, but needing support to realize good programs. Also, activities lying outside the scope of the main current in various areas of infotechnology may bring the program-carrier into a position worse than that before entering the program. The advantage lies with those enterprises which are capable of receiving information quickly, which possess sufficient high-quality manpower, and which can respond to challenges quickly. One should bear in mind that the market life of products and technologies for producing them in the field of infotechnology is very short - 4 to 5 years or less.

In this context, as seen from the point of view of the necessary support (including the financial one), co-operation at the level of small-and medium-scale enterprises in the field of infotechnology seems less risky and more certain for partners from developed and developing countries. This takes into account the ability of developing countries to support such co-operation. For most developing countries the most acceptable approach is to build "islands of modernity" within the country, which can communicate with the rest of the world and act at the global level, and which may become a stimulating environment for production in the field of infotechnology. According to L.M. Branscomb, every developing country should try to have its own Singapore, or Hong Kong, its own centre of excellence. These environments could become powerful transmitters of information, knowledge and programs to be distributed to other points within these countries, to various industrial and economic sectors.

In practice, the industrial co-operation in the field of infotechnology between developed and developing countries takes many forms. This variety is due to a wide range of infotechnological products. The usual forms of co-operation are joint ventures, foreign investments, contracts, etc.

Some concrete medels and cases in the field of computer software industry will be mentioned in the next chapter.

3. INTERNATIONAL CO-OPERATION IN THE SECTOR OF COMPUTER SOFTWARE INDUSTRY

3.1. Software Industry - General Aspects

Software is of critical importance in the context of general diffusion of infotechnology into all economies and societies. Software, defined as sets of purely conceptual data and instructions, is at the heart of all types and sizes of infotechnology applications.

Word processor systems, industrial automation systems and CA applications, communication and telecommunication system, data banks, industrial products based on microelectronics, electronic fund transfer systems, air, sea and road transport control systems and the various national defence systems, all operate via software systems. This all aids and promotes formation of new

specialized software firms rapidly increasing their investments, personnel and sales; although a good deal of costs of application of infotechnology remains within user firms and organizations, software production is one of fastest growing sectors in developed countries.

The essential role of software in infotechnology applications has become apparent in early eighties when it was understood that the spectacular advances in hardware components, mainly due to continued technological improvements and economic effects (price reduction) in semiconductor and integrated circuits, can become useful only if supported by good-quality software which would make them functional and available to many social and economic factors.

Awareness that serious technological and economic problems may hinder software development and distribution has led to a fear of the "software bottleneck" consequences. This is further reinforced by the fact that in most sectors of industry, education and government, the chances, challenges and possible difficulties in infotechnology applications are still mainly linked to hardware efficiency, cost and social applications, even in developed countries.

However, the time is ripe for the idea that software production should be treated both as a technology and as an industry.

Furthermore, software production is an engineering discipline still in the phase of its own formation. This means that professional qualifications necessary for software production are being formalized; a structure of explicit and complementary theoretical knowledge, subject to scientific research and engineering instructions, is being built. Software design is mainly based on intuitive and experimental specialist skills, although theoretical and practical tools for production and reliability improvement are being used increasingly more often. In that respect, among other software production phases, programming has witnessed a significant technological advance thorugh introduction of many high-level programming languages. But, advances in development and implementation of engineering tools and methods which improve definition, specification, design, quality and maintainability of software products are becoming increasingly evident.

However, it is obvious that software production will be extremely expensive, and the product will be of a relatively poor quality, especially in complex applications, for as long as software design remains a predominantly intellectual task involving little or no automation.

The economic status of software, which is treated and defined in different ways, leads to different forms of application of property laws, accountancy laws and tax laws. Various dilemmas exist: e.g. should a software product be treated as intellectual work to be protected by copyright laws or as a patentable product, could it be considered to be a valuable private asset or not, are the costs for software a current operating expenditure or an investment, should software sales be treated as sales of goods or services etc. Thus, these aspects reflect novelty and originality of software production as compared to other economic activities, which makes the organization and economic optimization of this production even more complex.

The market of software production factors, such as skilled labour and software engineering tools, and the market of software products, such as professional services and software products (packages), are being established, which still limits realization of their role of technology transfer channels and incentives for economic optimization. As regards the skilled labour market, one should emphasize the absolute lack of skilled manpower, which is constantly being increased by rapid changes in technological demands and in hardware and software environments requiring a continued and rapid updating of the skills of specialists.

However, regardless of many problems encountered by this "new" industry, the software industry is growing fast and dynamically. This may be seen by the increase in the number of software firms and by their expansion at the international level.

One should stress the fact that technical advancement, rationalization of software activities and growth of software industry cannot be wholy supported by autonomous and independent activities of software firms and organizations. This would imply realization of a series of public goods such as new scientific and technical knowledge, new configurations of professional skills, diverse infrastructures, appropriate standards and financial legislative and legal frameworks

and practices necessary for the unfolding of these processes. This would mean that, beside a number of other factors (large firms, technical societies, trade associations, etc.) governments carry a special responsibility for production of these public goods through aspects such as research, education and training policy, public sector software procurement, hardware production policy and its effect on software, governmental support in growth problems witnessed by software firms, foreign trade rules applied to software and legal aspects of software.

In countries aware of the importance of software industry, governments support software firms:

- *by including them in the "industrial" sector, enjoying the same support as other industrial firms,*
- *by developing support schemes for this sector, especially through public loans or aids to heavy and risky investment in software package development,*
- *by software procurement policy for public and governmental agencies,*
- *by general export promotion policy through financial and logistic support.*

It has been also noticed that the venture capital plays the crucial role in financing and idrecting new software firms.

Growth of investments into development and marketing, and the increase in market specialization, force software firms to make their activities international, especially in smaller countries. On the other hand, users try to find suppliers (producers) whose products and services meet their needs best, regardless of the country of origin.

In this respect, international trade rules applied to software are of extreme importance, especially in the context of development of international trade and co-operation.

3.2. A Survey of Software Market

Software technology, regardless of whether it refers to a final product or the production process, had predominantly "craft" features in the previous period: it was based on unformalized and unautomated skill of a few professionals, which dominantly determined the quality of the final product. Software existing

today at computer installations worldwide, produced by that technology, has mainly been produced through three main software production organization forms: production by a firm which is itself a user of software; production by a firm which produces infotechnology hardware; and production by a specialized software firm. The value of software installed in the three main areas of infotechnology application: data processing, microelectronic applications and industrial automation is estimated to be over 200 billion USD. This software has been produced mainly through the first two software production organization forms. The third form, production by specialized software firms, has proved to be more innovative, competitive and economical than the previous two, especially on the software package market, and is currently witnessing the highest growth rate.

Quality of software installed, as a direct consequence of existing software production quality, is partly below the quality class of other industrial products. This software is mostly poorly structured, non-standardized, difficult to maintain and buld on, and insufficiently reliable, which led to formation of the term "polluted" software characterizing most software products produced in the previous periods.

Appearance and application of new software production support tools and systems represent a significant step forward in the quality and productiveness of software production and in the quality and reliability of the final product. A wide range of CASE (Computer Aided Software Engineering) tools, new technologies and concepts (e.g. COMPACT - Computer-assisted Problem Conception Technology, NEC's SDMS - Software Development and Maintenance System, TOSHIBA's IMAP - Integrated Software Management and Production Support System, MITI's SIGMA - Software Industrial Generalization and Maintenance Aids, etc.) are being developed, tested and implemented. The goals of ambitious programs, of new advances in software production technology, and of increases in the final product quality and attractiveness are the following: an application specialist should be able to develop his/her application program by him/herself; manually specified and (semi-)automatically generated software should be more easily maintained; productivity of software production should be much higher.

However, present technological innovations in the whole field of infotechnology, and in the computer software sector, make it rather improbable to believe that these tools will diminish the need for highly trained and experienced manpower. On the contrary, the opposite is the case, as fields of possible application widen and sophistication of new infotechnology applications increases, with software at the core. Aslo, the CASE tools strategies imply widening of knowledge, but demand already experienced and skilled specialists. So it is certain that the computer software industry will experience increasing lack of skilled manpower in the years to come. E.g. the Japanese MITI forecasts that Japan will need 2,156,000 software engineers, and have only 1,180,000 available in 2000. This means that 976,000 software engineers will be lacking, which will bring about a crisis in Japan's software skills. The same forecast predicts that the number of software specialist lacking will be 251,000 in 1990, and 513,000 in 1995. Although Japan has one of the biggest and most dynamic economies as regards infotechnology production, marketing and application, similar analyses in other countries would probably indicate the same trends. Many studies and national and regional training and retraining strategies depart from the predicted lack of skilled manpower and try to find solutions for overcoming this problem.

Generally speaking, every new infotechnology application is a trigger for a kind of chain reaction for new creations and realizations.

The software product market will, as predicted, realize the average growth rate of 23% in the years to come. Between 20 and 30 billion USD was made by software product sales on the world market in 1988. If estimates that over a half of data processing costs remain within the user firms are true, one may believe that inhouse software production is of at least the same order of magnitude, which, combined with the sales data, illustrates the total worth of this production, as well as the market potential of this sector of infotechnology.

Some aspects of technological development (new computer generations), increasingly complex requirements of further industrial and economic development, activities on the plane of international economy, national and international development processes, put new and complex demands to the infotechnology industry, and to its computer software sector in particular, thereby opening new chances

for its development at the same time. E.g. global activities of industrial enterprises or firms from other economic sectors, and the increase of market competitiveness and requirements, put the strategy, quality and economics of infotechnology application in the center of interest. Many aspects of these requirements have not been yet satisfied. Another example: developed countries will have to reconstruct their "polluted" software in the next period by higher-quality, more powerful and rational software solutions, making its necessary integration possible. The next example is that of integrative processes in Europe which will demand a fundamental reconstruction of existing information and informatical solutions providing the basis for European and non-European firms today. Then, there is a highly dynamic market of software and systems applied to microcomputers, etc.

All these requirements, chances and challenges provide at the same time new markets for existing and new software producers and for extensive professional services, including all three basic types of software production - inhouse software development (with profit orientation), production by firms manufacturing infotechnology hardware, and production by specialist software houses, and any combination of co-operation between them.

3.3. Enterprise-to-Enterprise Co-operation in Computer Software Production

Complexity of requirements put to software industry makes international co-operation expected, desirable, productive, and even necessary in some aspects. Beside a naturally very developed co-operation between partners from developed countries, the co-operation between developed and developing countries is in constant increase, which is expected to continue, but mainly in those developing countries or environments that have secured necessary prerequisites for their enterprises to form and develop such co-operation.

Elementary factors of co-operation between developed and developing countries are primarily the lack and expensiveness of computer science experts in developed countries, and relatively high education standards in many developing countries. These factors provide an extraordinary opportunity for productive co-operation and marketing of software products. However, this co-operation must be based on application of new software production techniques, developing and

adopting at the same time the industry-oriented techniques and software production methods. Thus organized, software production would provide good-quality competitive software products and ensure the increase of knowledge and know-how, making it possible to initiate innovative processes. By innovating production technology or products, enterprises in developing countries might become partners almost equal in all respects to enterprises from developed countries, and might even start exporting technology.

Furthermore, there is a zone within the computer software industry sector which has been proved very suitable for international co-operation. That is the field of software systems for microcomputers, systems with high problem-solving potential and capabilities, which may be applied to and marketed in all economic sectors and areas of human work. It is relatively easy for enterprises in developing countries to secure necessary technological prerequisites for development of these systems and products.

In developing countries, various factors have led to formation of powerful kernels, either within existing enterprises or as independent units, with a relatively high level of knowledge and experience in the field of infotechnology, providing a potential for international co-operation with enterprises from developed countries. In order for this co-operation to be initiated, the following is necessary: a support for other areas, such as promotional activities, program and partner serching and selection, defining forms of co-operation, etc; necessary financial funds for providing demanding technological prerequisites, for possibly needed additional manpower specialization, for preparation and development costs, etc. This is particularly important as some advantages that enterprises from developing countries have in production and possible export of software (labour costs, skilled manpower availability) may be weakened by conditions at the software market and by dynamic development of infotechnology. Some examples show that this co-operation, which may be a significant incentive for software exporting, may also bring the partner form the developing country to a subordinated position by excluding it from brain-intensive, creative parts of software production. Therefore the importance of appropriate support lies in making almost equal the conditions of co-operation to both partners.

The role and use of international and national non-governmental organizations, and UNIDO in particular, in promotion and support in establishing international co-operation is of vital importance. So, e.g. consultant organizations and their associations may efficiently promote and organize this support, especially in the case of concrete arrangements between the consultant firm and a firm searching for programs/partners for international co-operation.

Furthermore, this can be done by national and international organizations performing or supporting international trade and co-operation (e.g. WTCA), national and international vocational and professional organizations in the field of infotechnology, etc.

The main role in co-operation stimulation and development is played by national and international financial institutions (e.g. development bank, industrial investment companies) which secure as equal starting conditions as possible to enterprises from developing countries and stimulate enterprises from developed countries to realize this co-operation (stimulating measures, guaranties, etc.). E.g. that might be the World Bank, but also other similar international and national financial associations supporting development, which should support financially ambitious and good quality innovative programs. Only such programs may lead to software products competitive on the international market.

Creative and capable personnel from enterprises in developing countries, backed by the necessary financial support for infrastructural prerequisites and appropriate motivation, may realize important technological innovations and reverse the direction of the technology transfer which is also a desirable course of events for the partner from a developed country, as a good innovation introduces new opportunities at the market.

In this context, international co-operation has been realizing its best results.

The reverse infotechnology transfer system deserves a special attention. One should distinguish between the transfer within the field of infotechnologies itself and the transfer within other economic areas. In both cases the object of the transfer is suitably innovated software result. As has been mentioned, innovating in the field of infotechnology is very complex and

demanding, and yet not unattainable for enterprises from developing countries. However, the actual space open for innovations is objectively narrowed. Many more opportunities lie in the second area. In developing countries, and in their enterprises, there is a highly educated personnel potential capable of innovating many areas of classical production categories, many products and classical services, by building new knowledge and solutions into specific software products. These software products, being knowledge based, or of the expert type, may become technological innovations of interest for the partner from a developed country, and possibly for the international market, too. This means that the usual, already established forms of co-operation between enterprises from developed and developing countries in the area of classical industry and services, may lead to a co-operation resulting in new, valuable software products. The in-house software specialists and specialists in appropriate specific application areas would participate in the process of creating such products, which means that co-operation, or realization of new software products, may take place outside firms specialized for software engineering. In this case, application specialists would play a specific role, being aware of the needs, capabilities and problems in their application areas.

The following model, making a reverse infotechnology transfer possible, is formation of consortiums of different specialist consulting and project organizations and software houses which might offer to innovate some technological processes and technologies used by enterprises from developed and developing countries. This might include new software products for some fields of banking, transport, management, education, etc.

International co-operation already established between enterprises from developed and developing countries in various economic areas may act as a channel for defining present needs and for promotion and marketing of results obtained by activities described - new software products.

3.4. Some examples of international co-operation in the field of computer software production

Many companies from developed countries, faced with the software crisis, search for a location and a partner suitable for co-operation in order to reduce their costs and increase the scope of their software activities.

E.g. the French international bank, Banque Indosuez, whose international network covers more than 60 countries, has almost all the code and documentation for the Indosuez's new international banking system produced in Bombay, India. This bank has, together with the Indian joint-venture company Tata Unisys Ltd., established a new international software development and support centre.

America Express, Ford Motors, Swiss Air, Yamaha, National Westminister Bank, and Fireman's Fund Insurance Corp. all use the code developed in Indian software houses.

Citibank has set up its own Indian subsidiary, Citicorp Overseas Software Ltd., to handle some of its in-house development and to provide software services to other financial institutions.

Mercy Hospital in Miami uses the clinical software system developed in Chile.

Many American firms use the less expensive CASE tool called POSE, developed by the National Computer Board of Singapore.

IBM has signed a contract with a Singapore firm Computer System Advisors to design and produce a several-million-USD-worth applications for the Singapore's public electronic data interchange network.

Boeing Services, Good Year, United Laboratories, and Asian Development Bank co-operate successfully with the Philippine software house System Resources.

Hewlett-Packard, Apple, Data General and NEC have established their software development centers in Singapore.

Texas Instruments has organized software production in Bangalore, India, which is transferred to Dallas, Texas, via satellite. Microsoft is also planning to establish a software development centre at the same location.

System Dynamics Corporation - Toronto, Canada and the Transport Institute, CIP - Belgrade, Yugoslavia, have formed a joint venture firm CIP/SDC for software production and distribution. The Canadian partner has invested the

methodology and technology, as well as the modern hardware, while the Yugoslav partner has secured the highly educated and experienced specialists. Thirty software specialists are working on production and support of packages covering planning and production control and transfer of goods and financial means.

Analysis of various cases of co-operation (including the examples mentioned) leads to a general conclusion that the international co-operation in the field of computer software development is mainly based on small-scale and medium-scale firms, located in developing countries.

4. ACTIVITIES TO BE UNDERTAKEN BY UNIDO

We suggest that UNIDO consider and evaluate the following schemes of possible activities which seem useful for establishing international co-operation in the field of infotechnology:

1. *Establishment of a global international computerized information service (possibly within the solutions already adopted) which would provide information relevant for successful co-operation in the field of infotechnology to all interested parties. Such information service might consist partly of a compilation of existing relevant information sources, with contents providing for a complete and efficient service added. E.g. besides providing information on the state-of-the-art in the field of infotechnology, and other relevant information, this service might be a kind of a supply and demand exchange for co-operation programs, available capacities, capital, new technologies for infotechnology industry, etc.*

   Costs of service establishment and operation might be covered by contributions of various interested partners (governments, various financial associations, international agencies, international firms from various industrial branches, etc.), and also, partly, through billing services rended.

2. *Organization of regional forums on the topic of international co-operation in the field of infotechnology production, and specialized regional meetings on the topic of "news and trends" in various infotechnology sectors, accompanied by promotion of successful exapmles of international co-operation.*

3. *Forming separate financial funds for stimulating establishment of international co-operation, directed by UNIDO; UNIDO should, together with possible partners, determine the financial sources and forms, and criteria for selection of projects competing for such financing.*

RECOMMENDATIONS AND TOPICS TO BE DISCUSSED AT THE EXPERT GROUP MEETING

We suggest that the experts discuss the following issues and topics:

- Is organized support desirable, and in what forms, in initiating and establishing a co-operation between enterprises from developed and developing countries? Can some of existing systems and solutions at the international level be used? What is the role of UNIDO and its possible contributions (as an international global industrial information node, for example)?

- Is it possible to define the minimum group of factors influencing initiation and development to successful international co-operation, especially in the field of sophisticated products and high technologies?

- As infotechnology has been increasingly included into modern industrial production and products, possible forms, models, and modes of efficient diffusion and application of infotechnology in all industrial branches should be discussed, especially as the infotechnology application level is one of the key prerequisites for establishment of international co-operation in the field of sophisticated production. The role of UNIDO and its possible modes of operation should be discussed.

- Flexibility of an industrial enterprise and infotechnology. Relation and consequences.

- What are the possiblities of and approaches to innovating "industrialization" in developing countries - avoiding old paradigms used in developed countries (development and implementation of non-agressive technologies protecting environment, rational exploating of natural resources, etc.) through establishment and development of international industrial co-operation.

- Should governments in developing countries take some actions to promote international co-operation, and to what degree; is it possible to prevent "brain drain" from developing countries in order to secure prerequisites for realization of their own development programs and for establishing high

quality international co-operation in the field of high technologies.

- The role and the influence of national and international financial associations in promoting and establishing international co-operation in the field of high technologies.

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