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World Federation of Engineering Organisations

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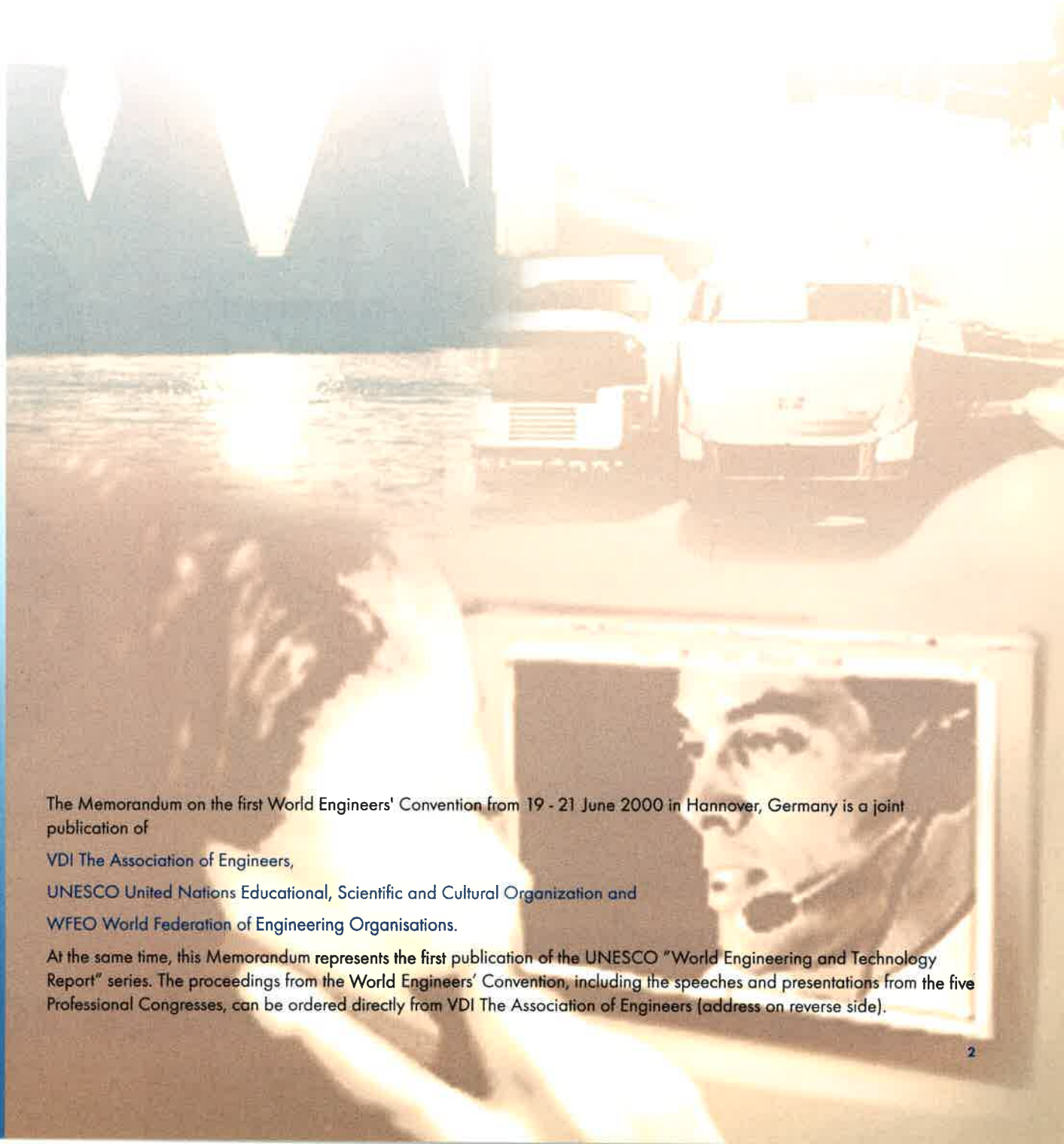
World Engineers' Convention

19 – 21 June 2000

EXPO2000 HANNOVER

Memorandum on the World Engineers' Convention 2000



The Memorandum on the first World Engineers' Convention from 19 - 21 June 2000 in Hannover, Germany is a joint publication of

VDI The Association of Engineers,

UNESCO United Nations Educational, Scientific and Cultural Organization and

WFEO World Federation of Engineering Organisations.

At the same time, this Memorandum represents the first publication of the UNESCO "World Engineering and Technology Report" series. The proceedings from the World Engineers' Convention, including the speeches and presentations from the five Professional Congresses, can be ordered directly from VDI The Association of Engineers (address on reverse side).

Memorandum on the World Engineers' Convention 2000

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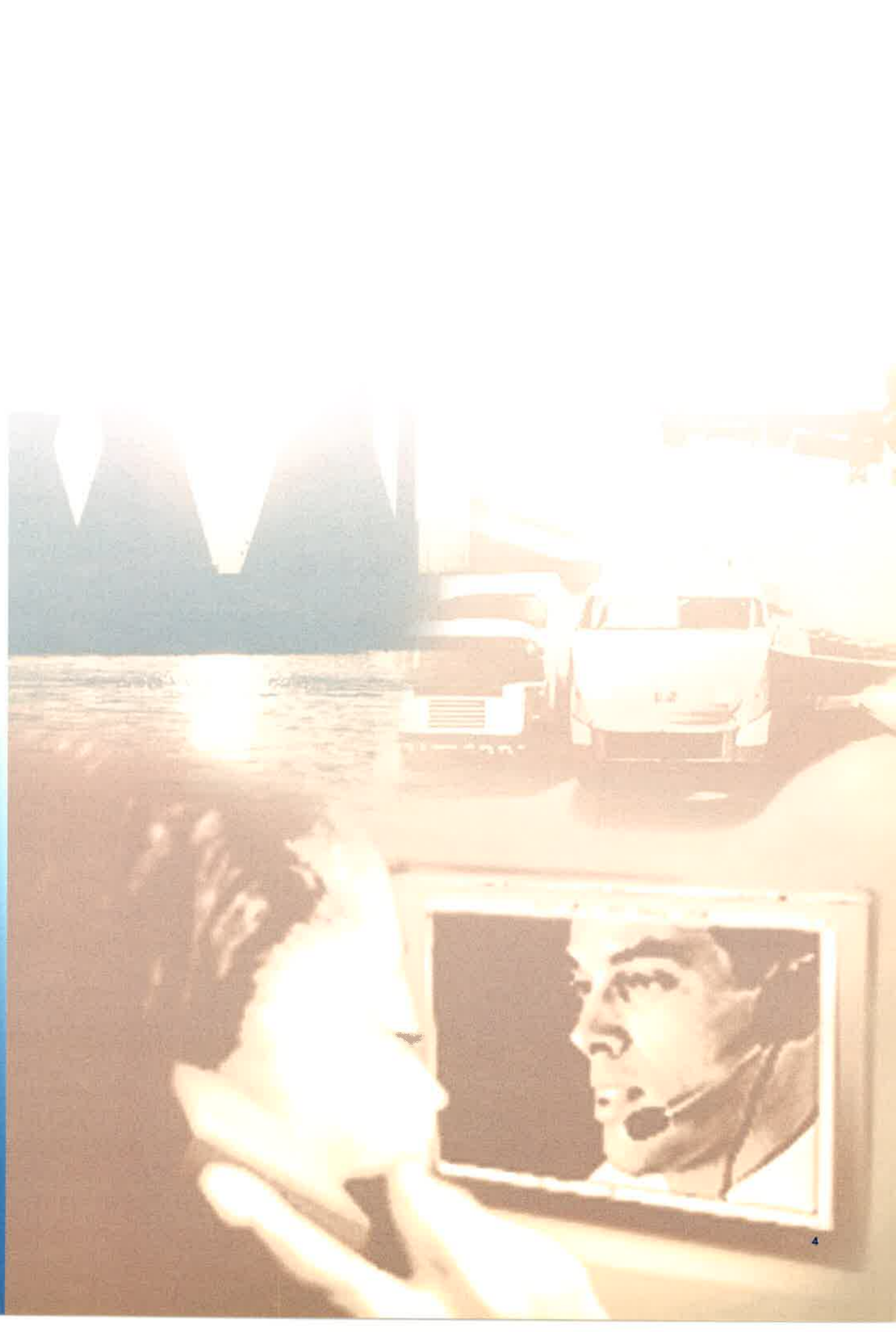


Preface

by Hubertus Christ, President of VDI The Association of Engineers, Germany

Parallel to the EXPO 2000 in the newly-born 21st century, around 3,500 engineers from 44 different countries met in Hannover under the banner of the EXPO theme "Humankind – Nature – Technology" to take stock of the world. Their shared goal was to find visions and solutions for central future-oriented issues concerning humankind and to put these results up for international public discussion. This publication is a compilation of the Memorandums of the five Professional Congresses of the first World Engineers' Convention. They deal with the topics of "Mobility", "Energy", "Information and Communication", "Environment – Climate – Health" and "Future of Work" and in their entirety give answers from the engineers of the world on globally pertinent issues. The Memorandums encompass, for example, the following questions:

How can our continually and rapidly growing populations – by the year 2020 the overall population of the earth will have reached 7.5 billion – be supplied with intelligent and globally networked traffic systems to satisfy all mobility needs.

How is it possible to supply energy to the two billion people on our planet, who up to now have not had access to a commercial energy source – and who are therefore forced to accept a much lower standard of living – and to determine the energy carriers and safety standards that can cope with growing global energy requirements.

How can engineers contribute to the solution by creating political framework conditions for implementing new information and communication technologies, so that all of humankind – regardless of time or place – can get in contact and communicate with one another.

How we can finally succeed, with the help of technology, in rectifying the environmental damage we have ourselves caused – both regionally and globally – and how can engineers form and maintain global alliances for achieving sustained development.

How can the key factors for employment – namely the effective implementation of new technologies and innovations and "lifelong learning" – be better deployed in organizational structures within the framework of global economies, markets and social relationships.

The papers of the Memorandums clearly illustrate how the first World Engineers' Convention surpassed many kinds of boundaries: those between industrial and developing countries, between the generations, between specialist fields, and also between the sexes – after all, the engineering profession was until recently a male-dominated field.

No longer just details or regional problems, the issues concerning all of humankind have come to the fore. For us engineers, being a part of the first-ever World Engineers' Convention was comparable to being a group of astronauts from various different countries travelling together on a space ship. Upon returning to earth, they report how, on their first day in space, they each searched for their individual homelands far below on the surface of the planet. Then on the second day in space, only continents could be discerned when they looked down: Europe, Asia, and America. By the third day everyone was aware that they all shared one and the same home planet.

With these five Memorandums from the first World Engineers' Convention, we engineers accept our responsibility for the development of technology on our home planet, and we demand to be allowed to shoulder this responsibility. While the task of politicians is to decide which results are to be achieved with the help of technology, it is the duty of engineers to find out which technologies are to be used to this end. If politics are allowed to dictate or prohibit individual technological solutions, the result will be the death of our creativity and the loss of better solutions.

Preface

by Koïchiro Matsuura, Director-General of UNESCO United Nations Educational, Scientific and Cultural Organisation

Breakthroughs in technology and new products and processes are continually enriching our daily lives, but have become so apparently commonplace that we all too often take them for granted, and tend to overlook them. This is unfair. It is important for us to remember the vital contribution of engineering and technology to development in general. Such was the message I conveyed by video when the First World Engineers' Convention gathered last 19 June 2000.

Fyodor Dostoevsky, the famous Russian writer, was also by training an engineer, and he never quite forgot it. He thus stressed the need "to strive consciously after an object and so to engage in engineering - by blazing new roads wherever they may lead". As we enter the 21st century, it behoves us to continue blazing new roads in engineering - by identifying needs, by provoking fresh insight, by developing policies to cope with technological change and globalization. We encourage international commitments to promote the kind of engineering and technology which contributes to lasting development around the world.

So much was emphasized at the World Conference on Science held in Budapest in July 1999. The goals set there can best be achieved through national, regional and international cooperation, and the sharing of ideas, information and resources through diversified and innovative partnerships. Extant cooperation should further be developed between UNESCO and such groups as the World Federation of Engineering Organizations, the Union internationale des associations et organisations techniques, both founder members of the International Council for Engineering and Technology.

I am very happy that the VDI the Association of Engineers, Germany invited such cooperation in the First World Engineers' Convention, which brought together so many governmental, intergovernmental and highly qualified professional organizations with the precious participation of numerous and prestigious private firms. UNESCO looks forward to playing a partnership rôle in follow-up initiatives. These include publishing these memorandums as part of a collective and ongoing World Engineering and Technology Report - of which this is the very first issue.

I congratulate the organizers for the fine way in which they have marshalled and presented these materials.

Fédération Mondiale des Organisations d'Ingénieurs

World Federation of Engineering Organisations

Preface

by José Medem Sanjuán,
President of WFEO World Federation of Engineering Organisations
President of ICET International Council for Engineering and Technology

During three days, in June 2000, 3500 engineers from 44 countries gathered in Hanover at the invitation of the VDI the Association of Engineers, Germany, the National Member for Germany of the World Federation of Engineering Organisations. This first "World Engineers' Convention", which took place within the framework of the World Exposition EXPO 2000 allowed the participants to present and analyze the visions and solutions offered by the engineering profession to the main theme of the EXPO: "Mankind, Nature and Technology". This was for them an opportunity to stress their role as a bridge between Science and the Society.

It happened that at the same time UNESCO and the International Council for Science and Technology (ICET) were studying the possibility to publish, as had been suggested by several UNESCO members during the 1999 World Science Conference in Budapest, a periodical "World Report on Engineering and Technology".

As the President of ICET and of WFEO, I would like to express the gratitude of the world engineers to both UNESCO and VDI for accepting to join their efforts and publish the proceedings of the first "World Engineers' Convention", where the "state of the art" of technologies in the fields covered by the "World Engineers' Convention" is described, as the first phase of the "World Report on Engineering and Technology". This document will help bridging the boundaries, between generations as well as between nations. It will, in particular, assist developing countries in narrowing the gap with industrialised ones.

The pioneer achievement of VDI, which conceived the concept of the "World Engineers' Convention" and brilliantly led it to success is not to remain short-lived: we know now that China has accepted to organize the "World Engineers' Convention" 2004 in Shanghai. The Chinese Association for Science and Technology will join forces with the Chinese Academy of Engineering and the Shanghai Association for Science and Technology to set up what is going to become the second "Olympiads of Engineers". UNESCO will participate in this event and thus contribute in perpetuating the concept and the associated publication of the "World Engineering and Technology Report", for the benefit of the community of engineers and of mankind as a whole.

Memorandum
Information and Communication

The Information and Communication Technologies today and tomorrow are characterised by

- the Internet and its related technological developments
- mobile telecommunication systems
- video-based multimedia application for communication
- speech recognition/automated speech output

These systems are already being integrated into mobile hand-held tools which are getting smaller, more flexible and show increasing numbers of new functions. They are developing into embedded systems with invisible PC-free interfaces and into new breeds of robots and Multi-Agent Systems. These systems are excerting strong impact on society world-wide. They may allow everybody

- to communicate with anybody anytime, anywhere, by sound and picture
- to gather, store and retrieve any data and information world-wide,
- to make any business transactions within seconds: shifting huge amounts of money about; selling, buying, moving goods world-wide; remote-controlling machines and people across and between continents, etc.

The technologies will show symbiotic/adaptive patterns in dealing with humans: they sense human emotions and are able to respond to them, they model their own actions by copying human behaviour. Thus these technologies demonstrate their own "emotional" patterns of behaviour and change our perception of technology around us in our lives.

The technologies support co-operation of people by storing and retrieving the shared knowledge and experiences of the group and making them available to all members. They lead to new professional patterns of knowledge management and knowledge broking, continuous learning processes for everybody and new dynamics of groups.

Global communication networks trigger both strong economic co-operation and mutual dependencies of large enterprises and countries.

Information and communication technologies have contributed – or are about to contribute – to solving problems of society and to respond to age-old desires of humankind: e.g. to communicate with our partners independent from time and distance – in a similar way as trains, aircraft and cars are the responses of engineers to the desires of all of us for mobility and freedom. We all across societies with access to these means, enjoy these developments, we use them in our professions and in private life, we have fun and excitement, and we appreciate the business value and the financial perspectives and advantages going with the information and communication technologies.

Questions, however, are arising with these technologies in a similar way as with the other, today already more traditional technologies. Engineers are twice challenged by these questions:

firstly to follow them up through their professional and technology-oriented tasks

secondly, as members of society, to join in the discussions of the non-technical aspects and the social impact of technology.

The Discussion Forum – Summary of Statements

The following Trends and Challenges of Information and Communication Technologies are the results of the Congress on Information and Communication during the World Engineers' Convention 2000 in Hanover. They have been discussed and agreed on by the participants of the Congress workshops.

1. Global versus Regional Development: Law and Governance

Trends

The main trend today is towards globalisation: all communications and transactions take place within world-wide dimensions.

There is a counter trend: Regionalisation. This provides an opportunity for participation, identification and local governance. There will still be places where people meet face to face.

Challenges

The global networks have strong political impact on democracy, national and international security and the social welfare of all citizens. The development and implementation of new technologies frequently shape political decision-making.

To make the world a really global world we have to integrate all countries. We need to reconcile national laws at the international level as well as mechanisms to enforce them, without succumbing to any dominant perspective.

2. Entrepreneurship on Different Scales: Economics and Business

Trends

On the one hand, networking on a global "macro" scale is leading to both strong economic co-operation and mutual dependencies of large enterprises and countries. Optimum use of information mobility and the world-wide available information influence survival and profit of such networked enterprises.

On the other hand, small and medium-sized enterprises are increasingly becoming the backbone of economy and wealth of nations because they create the products, services and jobs needed for survival. In parallel, large enterprises increasingly understand their own employees as individual entrepreneurs on a "micro" scale.

Challenges

The liability and responsibility of global enterprises is no longer towards any specific country or people. There seems to be no control or governance possible through any single country. The economic-political impact of the global enterprises need increasingly to be taken into consideration.

In parallel, regions are challenging traditional national politics by developing their own political momentum.

3. Data Availability versus Data Security: Transportation and Processing of Data

Trends

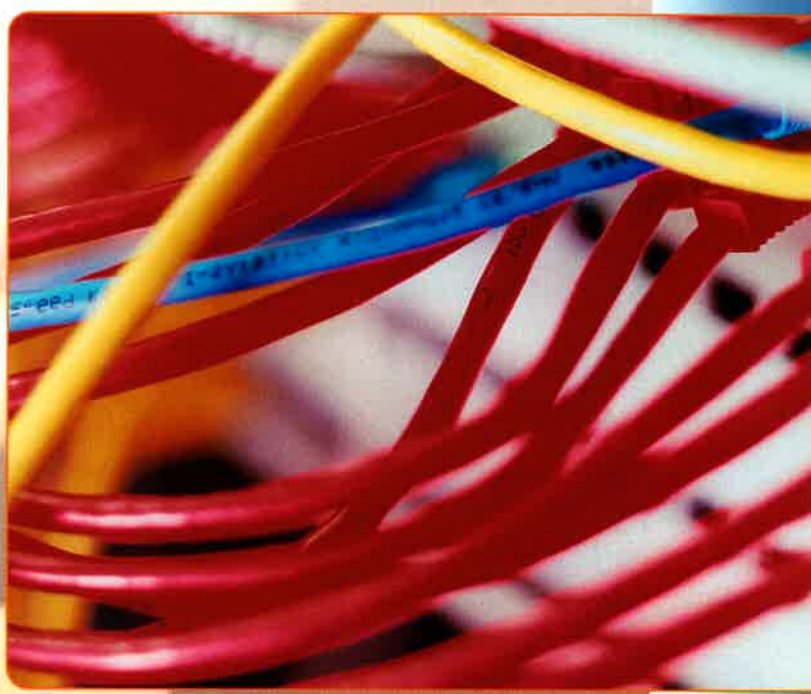
On the one hand, all information on the technological networks is available to everybody. Besides the personal desire for information and knowledge, these data are needed for all technical and organisational processes in business, production and for the protection of the environment. These data will grow in terms of both volume and complexity.

On the other hand, the misuse of the web and the breaking of data security are well known. Insufficient data reliability, trustworthiness and dependability are increasingly becoming a global problem.

Challenges

Data availability and data security are contradicting challenges on both the technical and organisational level. A new security culture needs to be developed concerning all developers and users. It may include to store sensitive and important data in physically separated systems like in safes.

New systems should restrict access to specific data in order to avoid any misuse. Not everyone world-wide should be able to know everything about everybody and everything – even if the web and the smart dust or embedded systems, the video-based surveillance networks and marketing profiles around us would allow it. The storing of unnecessary information has to be avoided.



4. Reality versus Virtuality: Acting within the Global Net

Trends

Within global nets we observe completely new ways of remote process control, and business transactions at a distance.

Furthermore everybody is invited to experience personally the enrichment of life by such technology-based information and co-operation. This development is a big step beyond the consumer attitude of the traditional TV – today everybody has started to become an actor on the web interacting with unlimited numbers of other actors. In this way the web offers the chance to learn about the past and the future and about different cultures which may help to lower prejudices and to overcome cultural boundaries.

Challenges

Many experiences today are transmitted only through the technological networks. Thus they are frequently not accompanied by experiences of reality. There is sometimes the danger that we forget all about reality outside the web. Individual web users may become isolated from communicating with people in reality.

5. Education: Technology-based and Traditional Education

Trends

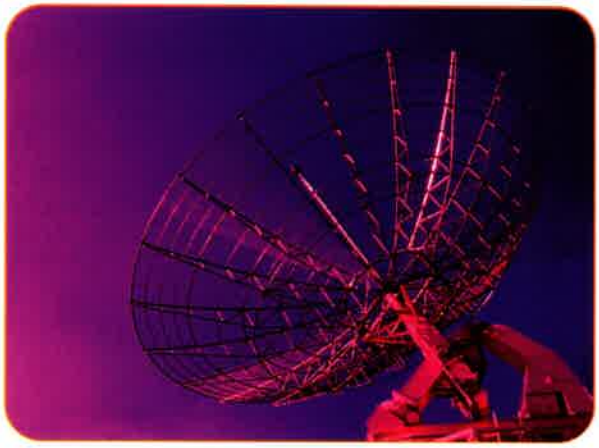
The growing availability of information and knowledge allows new educational use of the web. The speed of technological and societal changes forces people world-wide particularly to develop strong patterns of lifelong learning and continuously adapting to new conditions of life and work. Education will increasingly be based on the web and other related technologies (e.g. mobile and decentralised systems).

Challenges

All available knowledge must be easily and economically accessible for everybody on the web.

Many less wealthy nations and large groups within all nations, however, are not capable or cannot afford the means, to participate in technology-based lifelong learning processes.

All education and learning should not only be based on technology and virtuality but also on traditional forms of education, on the reality of personal, social and professional life. Education needs to develop appropriate methodological and educational approaches for the new media. Educators have to face their new roles in learning processes and to develop their knowledge of new technologies.



6. The Ethics of Multimedia Information and Internet-based Action

Trends

The calling-up and exchanging of information and pictures have proved their importance and necessity in personal life as well as in many fields of research, business, politics etc..

There is the trend towards using the internet increasingly for action and control. Furthermore it means to gain influence on private persons, institutions etc..

Challenges

There is the freedom of storing and sending all those pictures which symbolise the harmful or abusive side of human life (e.g. pornography, racism, violence and violent games etc.) It is unethical to transmit consciously and purposefully wrong and misleading information (i.e. misrepresentation of personal or group identity)

Recommendations

Based on the Memorandum and the Discussion Forum, the following statements describe the tasks which engineers as professionals as well as society and politics may perform in order to respond to the questions raised through the new technologies.

1. Global versus Regional Development: Law and Governance

Tasks of Engineers:

- To provide robust and affordable IT-infrastructure for developing countries
- To contribute to more political control of technology-triggered developments through making more information available to all citizens
- To create new search engines, filters and transformer systems which help to transform available data and information into knowledge as a basis for understanding of what is really happening around us and with us
- To design networks to support bottom up and horizontal links so as to facilitate a political dialogue and strengthen local ties

Tasks of Society and Politics:

- To take into consideration control and governance of technological networks and their economic impact
- To discuss the political impact of global networks, the issues of democracy, national and international security
- To activate independent international organisations for balanced political intervention
- To make use of the mutual dependencies in order to counteract the dangers of new technologies for new software-based wars
- To strengthen or establish mechanisms for transforming scientific and socio-economic assessments into information suitable for both planning and public information – following the suggestions of the Agenda 21 (Rio 1992)
- To give high priority to regional development in comparison to the global orientation in politics
- To provide publicly available points of access – such as libraries, cafes, clubs etc. - for proactive and productive use of the networks
- To seek an appropriate balance between public and private interests in knowledge and information
- To find creative solutions to promoting access to information and knowledge while at the same time allowing nations and regions to preserve their cultural traditions and ways of life

2. Entrepreneurship on Different Scales: Economics and Business

Tasks of Engineers:

- To get across to the public the strategic importance of communication
- To develop user-friendly, stable and secure technological networks for global business and transactions
- To see themselves not only as the designers of new technologies and products but also as entrepreneurs producing and selling them
- To start their own business in information technologies right out of their university career while keeping the co-operation with their university alive
- To create new business networks within their region thus contributing to the survival of their own region in the global competition
- To be involved in social and political aspects of communication technology

Tasks of Society and Politics:

- To develop new international co-operation schemes shaped as self-regulating business processes
- To reduce policy obstacles to market entry of SME's in communication technology
- To strongly increase international political co-operation in order to control the dangers of criminal business activities (e.g. enterprise pressures and blackmail)
- To create awareness for, and adapt policy to a joint design and implementation of technological and organisational renewal
- To actively encourage and support the creation of new work attitudes which complement traditional ones

3. Data Availability versus Data Security: Transportation and Processing of Data

Tasks of Engineers:

- To design transparent and easy to use interfaces for complex systems
- To design tools for data availability and data retrieval in complex systems
- To design data processing systems in a way to take into account the need for security of personal data
- To design technology for the contradicting challenges of data availability and data security
- To develop new filter systems, next-generation firewalls and coding systems which specifically prevent misuse of data and information, including surveillance and industrial espionage

- To develop new methods of user identification (i.e. biometric tools)
- To develop "fool proof" security systems that can not be overruled by their users
- To realise a variety of security processes for different control levels (i.e. machine control, maintenance and service)

Tasks of Society and Politics:

- To take care of the individual web users not to become totally transparent
- To establish national and international democratic control concerning agencies and technologies for gathering data and information about people and business, and concerning the access to such data markets
- To develop new regulations for data access and data use in order to protect individual freedom and personal data security
- To define regulations for super-users of technological systems without predominance of these super-users
- To educate people how to deal with security issues
- To develop a (re-)definition of data that are necessarily private and those being important for the public
- To internationalise laws concerning data security, and to establish an UNO organisation for data availability and security ("UNESCO Control Panel")

4. Reality versus Virtuality: Acting within the Global Net

Tasks of Engineers:

- To develop further the technologies so as to keep reality in view while moving within computer-transmitted reality or computer-generated virtuality, e.g. through "augmented reality"
- To design automation and control technology networks (e.g. power stations, factories, aircraft etc.) so as to ensure that a competent human operator or system manager remains in charge of the system and is able to respond in an emergency
- To design communication and co-operation networks in a way to expect and encourage users to meet personally with their communication partners
- To focus further virtual reality development on the user interface towards "symbiotic" patterns of Human-Machine Interaction

Tasks of Society and Politics:

- To strengthen the responsibility of the human operator
- To take care of individuals web users not to become isolated from real life and social interaction

5. Education: Technology-based and Traditional Education

Tasks of Engineers:

- To develop further technology through interdisciplinary and intercultural co-operation in order to make the world-wide available information and knowledge easily and economically accessible for education and life-long learning
- To create new Global Virtual Learning and Meeting Rooms which cut across cultures and social groups and integrate past, present and future
- To design teaching/learning technology so as to expect and encourage learners for their education not only to rely on the web-based information but to confront themselves with reality outside the web and the media
- To develop for the less wealthy nations information and systems which are cheap, stable and easy to use (e.g. satellite based communication)
- To join into the discussion of the impact of these technologies on education across different cultures
- To suggest concepts of what kind of technological skills are to be taught

Tasks of Society and Politics:

- To implement technology and to develop further concepts for life-long learning based on mobile communication and the web (e.g. the Virtual School and University)
- To enable everybody across society to use and master information and communication technology leading towards new appreciation of the engineers' roles and contributions within society
- To provide means for all countries to gain free or cheap access to the web

for education of all people while taking into account their cultural differences, traditions and value systems

- To provide world-wide publicly available points of access for education (e.g. libraries, cafes, clubs etc.)
- To continue the efforts to integrate the web into education of schools, universities etc.
- To generate more knowledge in educational methodology for the responsible and efficient use of technology
- To take care that education remains founded in real, complex learning situations incluxding a wide spectrum of non-technical, real-life experiences
- To allow people time to get used to new IT technologies
- To guarantee continuing education of teachers
- To define standards for the educational use of the web
- To challenge the engineers on the technological contents and approaches in education

6. The Ethics of Multimedia Information and Internet-based Action

Tasks of Engineers:

- To reinforce the individual responsibility of the engineer by a professional code (like the Hippocratic Oath)
- To enforce and strengthen the discussions of what misuse of information technology may mean
- To design tracking systems for people who misuse the web (similar to the procedures for tracking hackers)
- To develop new kinds of filters to check web contents in a way to prevent the transportation of harmful and abusive pictures into and across the web

Tasks of Society and Politics:

- To discuss the ethics of information and pictures in view of the cultural pluralism of countries, their different traditions and value systems while avoiding to establish any one value system across the world
- To carefully observe the web and associated technologies in order to become aware of harmful and abusive uses
- To develop new self-regulatory international standards of what may or may not be done through the web and the related technologies ("Ethical Code" of global perspective), as an interdisciplinary effort of society integrating engineers, philosophers, business, politics etc.
- To stimulate business to create regulations ("Code of Honour" of global business) in order to prevent misuse of the business networks for harmful purposes
- To stimulate society and politics to define limits of using information and communication technologies:

Memorandum
Environment, Climate, Health

1. Environmental Policy

Two trends have influenced environmental policy over the last thirty years: Firstly, the shift from local environmental problems that were to the fore of environmental policy priorities in the 1960s and 1970s, through regional issues such as forest damage and river pollution, to global ecological damage such as climate change, holes in the ozone layer and desertification, as well as the associated problems of urbanization and migration.

The second trend can be seen in the measures undertaken to combat such damage. These began with 'end-of-pipe' techniques which reduce emissions at the end of the waste air and water pipes in production plants and were used in the waste disposal field. Increasing technology and government controls have advanced towards

emission and waste avoidance measures by changing production processes, products and also the behaviour of retailers and consumers. Politically, this second trend, however, leads to governments encroaching increasingly on the freedom of those producers, retailers and consumers. On the other hand, comparisons made by political scientists between Eastern/Central European countries and Western European countries in the period up to 1989 show that countries with liberal market economies are also more successful in terms of environmental policy than state trading countries. Since this is the case, the aim of modern environmental policy must be to allow producers, retailers and consumers to act of their own accord in an as environmentally acceptable and economically viable manner as possible so that governments do not have to infringe their freedoms. Governments or international communities must, however, set quality targets and threshold values with which producers, retailers and consumers must comply and they may threaten with governmental intervention if these limits are not complied with voluntarily.

2. The Role of Technology

At a World Engineers' Convention, the role of technology in this process is to the fore of discussions. Many people consider technology as the main reason for the ecological crises that have occurred in various countries at various times since the beginning of industrialization. By applying technology, mankind has damaged the environment in which it lives. However, experience also shows that repairing the damage caused to our environment is not possible without technological measures. We will not be able to prevent environmentally harmful developments simply by refusing to use technology and by the sparing use of natural goods alone, particularly since technology has also

helped to increase the world's population and to guarantee their means of livelihood which, in turn, leads to an even greater consumption of natural resources.

3. Mankind, Technology, Eco Balance Sheets

Both as a condition for government regulations and as a basis for voluntary self-regulation and a requirement for eco-labelling also suitable for product advertisements, it is important to establish and also to publish the best available technology (BAT) for specific processes and products. Particularly at a time of increasing globalization and liberalization of world trade, it is crucial that the optimum 'state of the art' is not only established by national bodies and authorities but also by international bodies such as ISO. The same goes for measurement and analysis procedures and the statistics that support them. One example for this is the difference between Romanian and Serbian standards in the recent incidences of cyanide emissions from a gold mine.

For ecological comparisons, the so-called eco balance sheets, we also need committees that are independent of economic interests, which can compare and evaluate the various alternatives. Since there are often no calculable yardsticks available for this (one example being nuclear energy/fossil energy), it is impossible to manage without conventions in which national and emotional factors can also play a part (for example: the speed limit on motorways).

For such political decisions, too, it is important that policy makers are provided with the impartial expertise of engineers. One key aspect of medical issues is the question of how and when an environmentally relevant effect can lead to health damage. Environmental medicine in particular frequently has to take into account subjective sensations of illness of which the often underestimated effects of noise and unpleasant odours are well-known examples. In this respect, evaluation by independent bodies with no economic interest is vital, as well as the information of the public and regular examination of scientific findings.

4. Environmentally friendly Products, Conflicts between Ecology and Economy

The more the environmental damage caused by certain products or processes is internalized in the costs of these products or processes – be it through government levies or the purchase of emission certificates – the more economically favourable environmentally friendly products and techniques will become. Nevertheless it will not be possible to avoid conflicts between ecology and economy in the future either. The most common reason for such conflicts can be found in the different timeframes with which economists and ecologists have to work; sometimes emission-reducing measures do not begin to pay off economically until after a period of more than ten years.

Government and other public subsidies are helpful in bridging these time differences (for example, medium-term fixed prices for supplying public electricity networks with solar and wind power). It is particularly vital, however, to set medium and long-term government targets and standards, (for example, taxes on hydrocarbon fuel fixed for a period of ten years – the average service life of a car). Limits also need to be set on the growth of consumption in natural resources. This makes it easier for an investor to calculate the point from which an environmentally friendly investment will also yield an economic return.

5. The Importance of Monitoring

Despite all the advantages that voluntary environmentally compatible measures have to offer, the use of best available technology must still be monitored. These controls can be carried out by government authorities, but also by independent environmental experts as provided for in the European Ecoaudit Regulation. Alongside these inspectors, who are independent of the companies they monitor, company representatives for environmental protection are becoming increasingly important. Although they are employees of the companies they monitor, in a professional capacity they are independent of their managements. They check whether their companies comply with environment-related regulations and make suggestions for improving environmental protection in the areas of planning, production and sales. They are to be involved in all decisions related to these matters and must also be experts in their professional fields, for example, qualified engineers.

6. Cooperation between Industrialized and Less Developed Countries

At a World Engineers' Convention in particular, the professional and also financial cooperation between industrialized and less developed countries is an important, if not the most important theme of the congresses. Since ecological priorities – as mentioned earlier – have shifted from local and regional problems to global dangers, the

significance of developmental policy for the protection of our natural resources has increased considerably. While the reasons that moved industrialized countries to give development aid used to be largely altruistic in the past, today industrialized countries must be egoistic, and in their own interest, make an effort to help less developed countries solve their ecological problems. The United Nations' target that industrialized countries spend 0.7% of their gross national product on development aid has not by any means been achieved by most countries. The convention's host, Germany, for example, currently

spends about half of this amount. The energy consumption of people in industrialized countries differs dramatically from that of people living in less developed countries - a fact impressively illustrated by the ECOSON indicator. Aid is therefore urgently necessary above all in the field of energy policy. This inevitably includes capital requirements for renewable energies, best technologies in forestry, charcoal and water power utilization and the consequences of environmentally damaging land use. In Kyoto a protocol on a "Clean Development Mechanism" has been passed but has yet to be implemented.

For this we not only need better financial assistance, but also technical and administrative advice. The increasing acceptance of emission certificates in particular requires the monitoring of the promised measures in both industrialized and less developed countries. These controls cannot be carried out by the donor states if we wish to avoid the impression of eco-imperialism. Rather economically and politically independent controlling bodies are needed - whether they are from the countries to be monitored themselves or institutions of the United Nations.

In this context, the principle of subsidiarity is also relevant, as strict laws are often passed in capital cities that nobody in the provinces takes any notice of and where no checks are made to see if they are being complied with. The financial independence of inspectors, i.e. adequate remuneration, is a prerequisite for effective checks to be carried out.

7. Training and Professional Development

For all these tasks we especially need sufficiently qualified engineers. In addition, a recommendation has been made that the field of 'Technology Evaluation' be included for ecological, social, cultural and economic aspects in the university education of all engineers and professional development courses offered by engineers' associations. In future we especially need engineers who are familiar with environmentally acceptable technology in industrialized countries and have also gained experience in less developed countries. For this reason, training engineers from less developed countries in industrialized countries and vice versa is vitally important for this field. The same applies to exchanging experience between industrialized countries and countries at industrial transition.

8. Outlook

Engineers play an important role in the technological development of our world, but also bear a high responsibility for the damage to our natural environment. For this reason the engineers' associations with their numerous members must form and promote global alliances for sustainable development. Cooperation with international organizations such as UNEP, UNIDO and the WTO can also promote sustainable technological development worldwide. For this reason we recommend that the participants of the Professional Congress on 'Environment, Climate and Health' at the first World Engineers' Convention sign the enclosed international declaration on 'Cleaner Production' which has been drawn up by UNEP.

INTERNATIONAL DECLARATION ON CLEANER PRODUCTION

We recognize that achieving sustainable development is a collective responsibility. Action to protect the global environment must include the adoption of improved sustainable production and consumption practices.

We believe that Cleaner Production and other preventive strategies such as Eco-efficiency, Green Productivity and Pollution Prevention are preferred options. They require the development, support and implementation of appropriate measures.

We understand Cleaner Production to be the continuous application of an integrated, preventive strategy applied to processes, products and services in pursuit of economic, social, health, safety and environmental benefits.

To this end we are committed to:

LEADERSHIP

Using our Influence

- to encourage the adoption of sustainable production and consumption practices through our relationships with stakeholders.

AWARENESS, EDUCATION AND TRAINING

Building Capacity

- by developing and conducting awareness, education and training programmes within our organization;
- by encouraging the inclusion of the concepts and principles into educational curricula at all levels

INTEGRATION

Encouraging the Integration of Preventive Strategies

- into all levels of our organization;
- within environmental management systems;
- by using tools such as environmental performance evaluation, environmental accounting, and environmental impart, life cycle, and cleaner production assessments.

RESEARCH AND DEVELOPMENT

Creating Innovative Solutions

- by promoting a shift of priority from end-of-pipe to preventive strategies in our research and development policies and activities;
- by supporting the development of products and services which are environmentally efficient and meet consumer needs.

COMMUNICATION

Sharing our Experience

- by fostering dialogue on the implementation of preventive strategies and informing external stakeholders about their benefits.

IMPLEMENTATION

Taking Action to adopt Cleaner Production

- by setting challenging goals and regularly reporting progress through established management systems;
- by encouraging new and additional finance and investment in preventive technology options, and promoting environmentally-sound technology cooperation and transfer between countries;
- through co-operation with UNEP and other partners and stakeholders in supporting this declaration and reviewing the success of its implementation.

Memorandum
Transport and Mobility

I. VISION FOR THE YEAR 2020

Tomorrow's mobility - An opportunity and challenge for today's engineers

1. The link between economic growth and the increase in traffic volume will be severed as a result of a number of measures especially by regional division of labour and the cross-border linking of transport carriers.
2. An integrated transport system enables the use without restrictions for handicapped obstacles of the most suitable means of transport for each section of the journey.
3. Transport telematics increase the effectiveness, efficiency and quality of the range of transport on offer and enable a great variety of customer-oriented mobility services and intermodal traffic-management.
4. In addition, assistance and telematics systems promote the safety of transportation and persons. Road traffic will almost achieve the same level of safety as public transport and air traffic. The personal safety and security of users of all means of transport is increased by the effort of information and communication technologies.
5. Exhaust emissions from transport – excepting carbon dioxide (CO_2) – will achieve near-zero figures. The exhaust emissions from modern aircraft will be reduced to only 20 % of current levels.
6. CO_2 emissions from transport will be reduced to an internationally agreed level. Alternative energies, in particular natural gas and hydrogen, will be increasingly employed.
7. Today's figures for noise emissions in general and for road vehicles on road surfaces will be obviously reduced.
8. State-of-the-art planning instruments allow maximum economic effects to be yielded from transport investments.
9. Legislation promotes efficient transport systems thereby declaring its express support for mobility and efficiency of transport systems.
10. In the future even more people are employed in the integrated transport sector. Services for participation and transport/mobility will be increasingly integrated.
11. Countries with great economic power have efficient, effective transport systems and develop these in a well-targeted manner.
12. Suitable and tolerable mobility possibilities for third-world countries will be created, promoted and implemented.

II. HYPOTHESES

In order to realize the vision of mobility outlined for the year 2020 engineers see the following need for action:

1. Engineers must bring to bear their knowledge taking into account social, economical and ecological aspects to a greater extent than is required today and have a duty to actively shape the requisite dialogue with society, industry and technology.
2. The long-term and global effects must also be taken into consideration and elucidated by engineers.
3. Political institutions must reach a consensus at international level in developing and laying down objectives and frameworks (such as legislation, standards, taxes) for efficient transport systems and sustainable mobility.
4. International, national, regional and local transport concepts must be developed and implemented compatibly with one another with the greatest possible consensus between the various interest groups.
5. Transport systems are to be integrated nationally and internationally in order to realize supply in line with market conditions. The technical requirements for this must be developed by the natural science disciplines. Industrial, social and legal disciplines must collaborate in setting down appropriate framework conditions.
6. In addition to integrating systems, it is important to improve the safety, quality, efficiency and environmental acceptability of transport and to continue to optimize all its sub-systems. Key terms here are: driver assistance systems, new forms of diagnosis, sensor and actuator technology, new sources of energy and new types of drive systems, differentiated forms of public transport, mobility management and mobility consulting.
7. The opportunities provided by telematics must be employed consistently for the optimization and integration of transport systems.
8. Scientists, industry, society and politics must work together to identify deficits in the transport sector in order to initiate and implement research projects prospectively and use these as a basis for developing new solutions.
9. The industrialized countries must help newly industrialized and developing countries to introduce up-to-date technologies as swiftly as possible. They improve the basic conditions for autonomous development.

III. IMPLEMENTATION OF HYPOTHESES

Guidelines for realizing the visions for mobility in the year 2020 outlined from an engineering perspective

1. Engineers must bring to bear their knowledge taking into account social, economic and ecological aspects to a greater extent than is required today and have a duty to actively shape the requisite dialogue with society, industry and technology.

Mobility not only fulfills a basic human need for a change of location but is also a precondition for personal development and the functioning and economic productivity of a society based on the division of labour. Mobility, transport and transportation systems interact with one another and society in a great number of ways. With the growth of industry and prosperity, transport has increased sharply worldwide to date and this has occurred in part beyond an acceptable level.

The development and evaluation of transport concepts and the highlighting of areas requiring action always assume an awareness of the areas in which interaction takes place and the minimization of the conflicting goals which occur as a result. It is vital to advise politics and industry and to promote the achievement of consensus within society in an objective manner backed up by sound scientific knowledge.

Engineers make important contributions to the continued development of the transport sector: from analysis through development and evaluation to the construction and operation of complete systems. Engineers must bring to bear their knowledge and experience and thus contribute to putting potential problems and conflicting goals on the agenda in a timely manner, objectifying emotional discussions on the basis of facts and developing the solutions needed in good time in agreement with those involved and society in general.

2. The long-term and global effects must also be taken into consideration and elucidated by engineers.

The interaction of the overall transport system with industry, society and the environment far surpasses the responsibility of engineers for individual vehicles and traffic routes. In transport systems it is vital to consider the entire impact chain, starting with the necessary resources for building and operating transport systems, the use and effects of the operation and finally, the closing of materials cycles and waste disposal at the end of the service life. Due to the high demand for transport, particularly the aspects of resource consumption and emissions have taken on new significance, as they have a global impact far beyond regional boundaries. Engineers must do their part in registering and assessing the diversified interaction of transport, both in terms of quality and quantity. It is important to point out the critical effects of transport and to view them as opportunities for developing new solutions for old problems.

3. Political institutions must reach a consensus at international level in developing and laying down objectives and frameworks (such as legislation, standards, taxes) for efficient transport systems and sustainable mobility.

As a result of political borders being broken down and the accompanying growth in traffic, new solutions are needed for handling this traffic in a sustainable manner for the transportation of people and goods. Sustainability[1] means guaranteeing that tasks are performed in a consistent and reliable manner. In this sense, sustainability opens up new opportunities for the further development of the transport sector in terms of international cooperation in the transport industry and developing new markets. New challenges are constantly posed both for the industrialized countries in maintaining their economic power and for the newly industrialized and developing countries with their increasing need for efficient transport systems. In a global free market economy, the use of individual transport carriers is determined by their efficiency and individual advantages. Therefore it is mandatory that international agreements achieve a broad consensus in laying down objectives for the sustainable handling of traffic and frameworks for competition, which are then to be implemented nationally by means of a suitable package of measures.

4. International, national, regional and local transport concepts must be developed and implemented in harmony with one another, with the greatest possible consensus between the various interest groups.

The aim of international, national, regional and local transport concepts must be to facilitate the human desire for mobility and the economically vital transport of goods in an efficient manner. As cross-border traffic has become very important for global market economies, compatible transport concepts and their cross-border realization are necessary.

Severing the link between traffic volume and economic performance and closing the materials cycles allows sustainable solutions to be created which ensure mobility whilst conserving resources, improving safety and reducing emissions at the same time. As needs arise in people's minds, a new understanding of mobility and its interactions must be promoted.

Transport is a 'derived variable': key factors determining the type and extent of mobility and transport needs are settlement and supply structures, school and administration structures and the organization of labour and leisure time. The specific mobility needs of men and women in the workforce deserve the same consideration as the mobility needs of children, youths and elderly people or people with restricted mobility. Since changes in transport frameworks tend to have long-term effects, timely, calculable decisions with the appropriate targets for market and regulative policy are needed. In order to ensure that such decisions remain valid over the long-term, reaching a broad consensus across all interest groups, administrations and differing political groupings must be a top priority.

5. Transport systems are to be integrated nationally and internationally in order to realize supply in line with market conditions. The technical requirements for this must be developed by the natural science disciplines. Industrial, social and legal disciplines must collaborate in setting down appropriate framework conditions.

Each transport system has its advantages and disadvantages with regard to the mobility needs and specifications for each transport job. Optimum solutions are thus only possible if the various means of transport cooperate on specific transport tasks. Supplementary service offers for the temporary storage or transport of luggage or bicycles, but also car sharing systems, can further enhance the appeal of public transport systems in particular.

Intermodal transport solutions which are attractive and economical for customers can only be achieved by harmonizing traffic infrastructures, means of transportation, data and information flows and organizational, legal and tariff-based frameworks. Multimodal traffic hubs such as railway stations, airports, inland and sea ports which – assuming that transshipment facilities and telematics are of the highest standard – enable the smooth transition between different transport systems and also form the essential backbone for their integration. Together with framework conditions for the competition between systems it will be possible to transfer the transport of people and goods onto the most suitable method of transport for each segment of the route.

A trend-setting concept for this are, for example, magnetic levitation (maglev) train systems such as the European Transrapid. Since the vehicle encloses the guideway, derailment is impossible. In addition, since there are no rotating components (wheels, engines, etc.), the acoustic emissions of maglev trains are very low compared to other means of high-speed transport: at comparable speeds approximately 50% lower noise levels with 30% less energy consumption. And thanks to the wear-resisting properties of the technology, maintenance costs are reduced by at least 50%.

For interregional and cross-border transport operations, standardized regulations, interfaces, compatible routes and means of transportation plus facilities and procedures for organizing, monitoring and controlling operational processes continue to be important. In addition internationally accepted procedures for testing, standardizing and approving components and systems must be developed in order to conserve resources and enable cheaper transport systems.

6. In addition to integrating systems, it is important to improve the safety, quality, efficiency and environmental acceptability of transport and to continue optimizing all its sub-systems. Key terms here are: driver assistance systems, new forms of diagnosis, sensor and actuator technology, new sources of energy and new types of drive systems, differentiated forms of public transport, mobility management and mobility consulting.

Low life cycle costs are to be aimed at as early as during the design phase. In special cases – after a careful cost-benefit analysis – the development of new transport carriers for specific purposes can be worthwhile.

The means of transportation themselves continue to offer considerable potential

- to improve target group-oriented utilization
- for increasing road safety,
- reducing energy and resource consumption and
- reducing noise and exhaust emissions.

Compared to the figures for 1970, technological progress has reduced exhaust emissions in the last decade to 3 %, halved noise emissions and increased vehicle safety by over 25 %. It is foreseeable that technological progress will become even faster. The following play a key role:

- the greater use of electronics with modern sensors and actuators,
- specific lightweight construction with higher percentages of aluminium and magnesium,
- the continued improvement of Otto and Diesel Motors,
- the use of improved fuels and alternative drive systems such as hybrid, fuel cell, CNG and hydrogen vehicles.

The quality of the transport system as an interchange between all individuals involved in the system could also be significantly improved through efficient mobility management in heavy-volume traffic networks. Further potential for improvement could also be developed in an interregional networking and intermodal expansion of the mobility management.

Moreover, continual and consistent customer-oriented offers, especially from public transport, create opportunities for realizing transport tasks more efficiently. For representation and comparison of mobility alternatives for the individual areas of transport tasks, mobility consulting has proven useful and has contributed to the increased appeal of public transport.

7. The opportunities provided by telematics must be employed consistently for the optimization and integration of transport systems.

Advances in electronics, communications technology and information processing offer great potential for improving traffic handling and supporting intermodal transport solutions. It is important to make use of this potential. As telematics not only encompasses systems for application in the transport field but also entire, new service chains, promising fields for development are emerging both in terms of transport and technologically and economically. In order to create wide acceptance and the trust of the public, the protection of personal data (for example in cases of integrated pay functions) must always be guaranteed in a manner which may be clearly understood.

Transport telematics offers travellers and customers increased quality of service when using intermodal forwarding and transport procedures, in particular by providing constantly updated information on planning, the progress of the journey or transport segment and documenting each change in transport method up to billing and payment. Transport telematics can also contribute to improving personal safety and reducing accidents on transport in general.

Transport telematics not only supports the integration of transport systems, but also offers great potential for enhancing transport safety and optimizing traffic handling, thus using existing infrastructure more efficiently.

- Collective traffic control technology has proven its worth in improving traffic flow and increasing safety in road traffic. Integrated traffic management and individual traffic control technology open up new opportunities for influencing traffic flows as regards traffic space and movement.
- Computer-assisted operating systems enable local and national public transport to use infrastructure more efficiently with better punctuality and improvements in guaranteeing reliable connections, an optimized incident management system and up-to-date customer information.
- For air traffic and shipping new solutions for operation, collision avoidance and monitoring and managing transport flow and space are also being developed.

In all cases supportive assistance systems increase the safety, capacity and comfort of transport systems. Prospective information, harmonization of transport flows and the increasing automatic guidance of transport offers further optimization potential including the reduction of energy consumption.

8. Scientists, industry, society and politics must work together to identify deficits in the transport sector in order to initiate and implement research projects prospectively and use these as a basis for developing new solutions.

The mobility and transport requirements of both industry and society change over time. Benchmarking different transport systems and different countries makes the existing differences, strengths and weaknesses qualitatively and quantitatively accessible in detailed analyses. Mobility research allows an insight into the many determinants and multiple interactions between transport, society and industry. Looking ahead, it is able to highlight emerging developments and possible trends in the economy and society together with its effects on the transport sector. The resulting findings are suitable for pointing out deficits and initiating the development of necessary solutions in good time.

In addition to the opportunities for transport telematics for all transport carriers already outlined above, for example:

- Refined simulation, planning and evaluation instruments provide opportunities for advanced analyses and improvements to processes and systems in transport systems and production.
- New materials, better materials cycles, lighter structures and advantageous additional properties provide the requirements for more efficient drives and lower exhaust and noise emissions.
- Electro-magnetically compatible electronics and data technology offer improved control and regulation

options for process optimization as regards greater efficiency, functionality and comfort - also for applications crucial to safety.

- New adaptronic systems provide greater comfort and safety and also contribute to the reduction of consumption by means of application-specific optimization, as shown by the first adaptive wings on research aeroplanes.
- Sensors, actuators and integrated systems in the microtechnology field offer approaches for new functionality, as well as space and weight reduction.
- Nano surface structures contribute to the reduction of frictional resistance, soiling and vehicle heating.

The foreseeable advances in science and technology still show enormous potential for development. Solutions which build upon this will also enable constant continued improvements and sustainable further developments in the entire transport sector.

9. The industrialized countries must help newly industrialized and developing countries to introduce up-to-date technologies as swiftly as possible. They improve the basic conditions for autonomous development.

The reduction of energy consumption and emissions is the objective of many current activities in the industrialized countries, and will have to be made a focus of efforts in the economically rapidly developing, densely populated countries in the rest of the world.

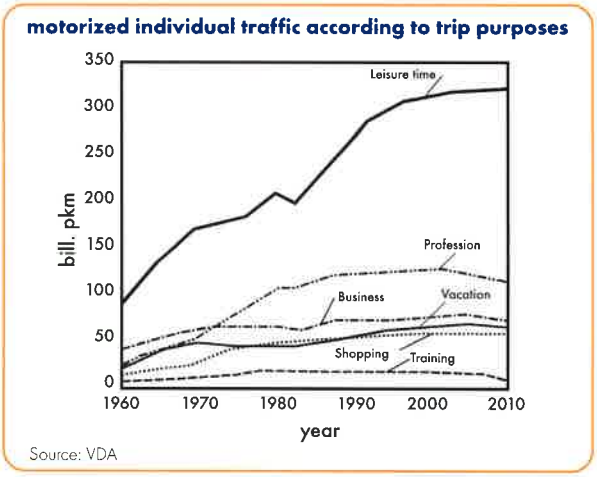
It is particularly important to provide financial support, the necessary training and advice for the newly industrialized countries in planning, building and operating their transport systems. The transport technology which is to be deployed is to be selected in accordance with the specific needs and requirements of sustainable mobility solutions and adjusted to the potential of each country.

This Memorandum is intended to promote the dialogue between engineers and all those involved, in order to put meaningful solutions into practice.

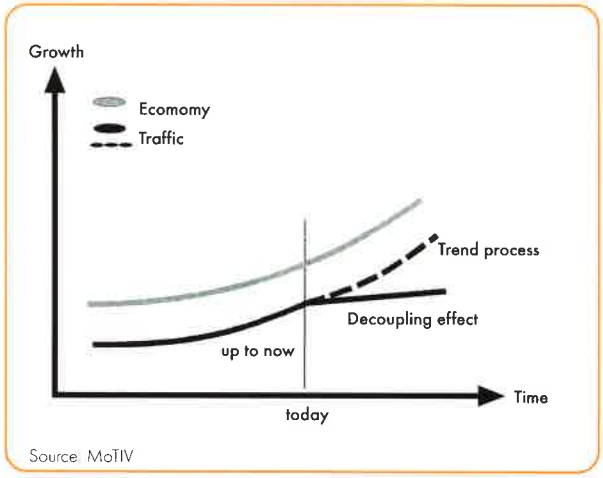
[1] Sustainability of transport is characterized by three aspects:

- Emission, energy and resource consumption of traffic have to be reduced to a minimum in order to avoid permanent environmental damage.
- Harm and damages of people – for example in terms of their health as a result of noise or accidents – have to be reduced to a level which society is prepared to support, after weighing up the advantages transportation systems offer.
- The strength of the transport sector has to be improved more and more so that it does not come to a complete standstill – for example due to traffic jams – or that it is not excessively sensitive to external disturbances.

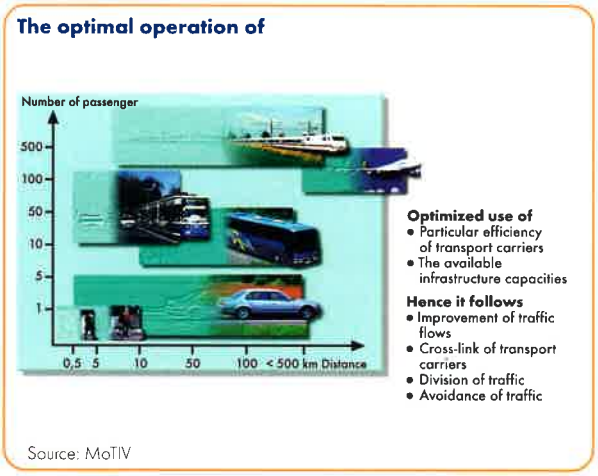
APPENDIX: VISION



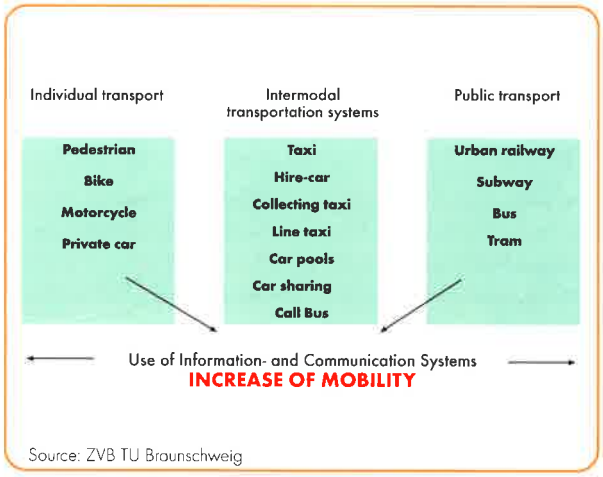
Vision 1: Development of Traffic Capacity



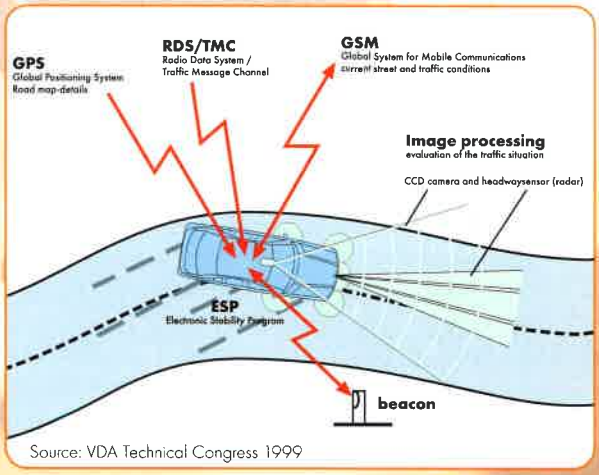
Vision 1: Decoupling of Growth of Traffic and Economy



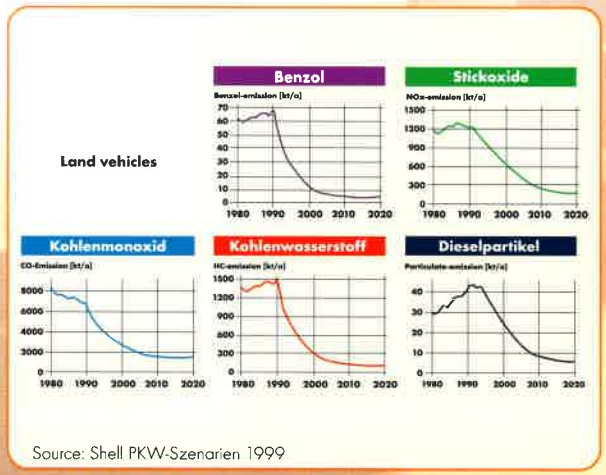
Vision 2: Discrepancy Traffic/ Infrastructure



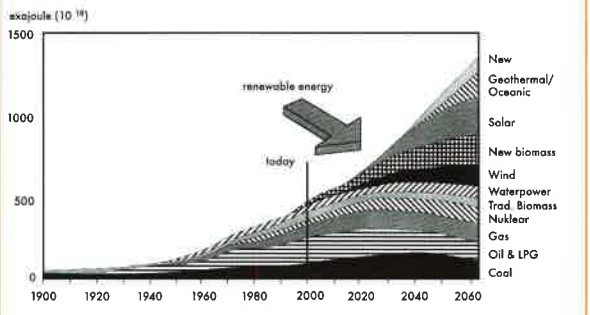
Vision 2: Cross-linking of Local Passenger Transport



Vision 4: Vicinity Sensors and Telematics for more Active Safety

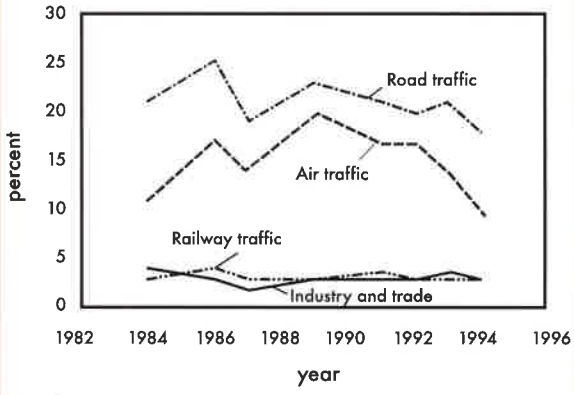


Vision 5: Drastic Drop of Emissions



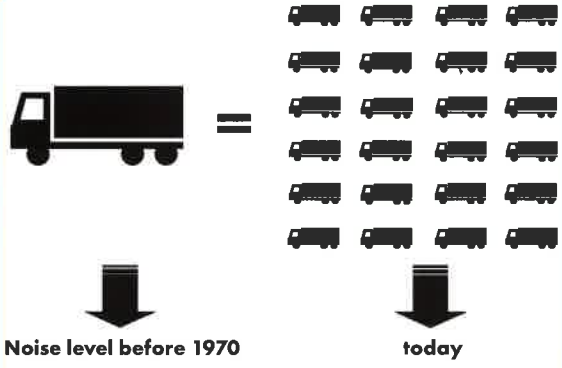
Source: Shell Global Solutions

Vision 6: Scenario: Worldwide Demand for Energy



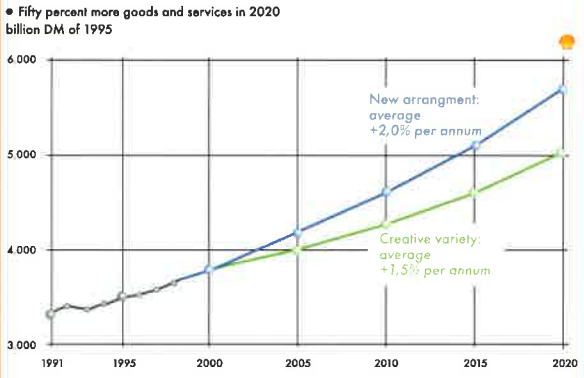
Quelle: UBA, 1998

Vision 7: Decrease of Noise Emissions of Commercial Road Vehicles



Source: UBA, 1998

Vision 7: Noise Emission



Quelle: Shell PKW-Szenarien

Vision 10: Gross Domestic Product in Germany

Value created	Total GDP is ECU 7164 billion or ECU 19200 per person • of which value created by the transport services sector was 4% = ECO 290 billion • in addition value created in own account transport was 1% 0 ECU billion
Employment	6 million persons are employed in the transport service sector = 4% of all persons employed In addition, 2 million persons are employed in the transport equipment industry, and over 6 million in transport related industries
Investment in transport infrastructure	Investment in transport infrastructure is ca. ECU 70 billion or 1% of GDP • of which 65% road, 25% rail and 10% other modes
Household expenditure	Private households in the EU spend ECU 600 billion per Year or 14% of their income for transport. • of which about ECU 500 billion for private transport (mainly cars) and ECU 90 billion for purchased passenger transport services.
Goods transport	Transport demand is 2770 billion tkm or 7400 tkm per person (20 tkm per person and day) • of which road 43%, sea 41%, rail 9%, inland waterways 4%, pipelines 3%
Passenger transport	Transport demand is ca. 4830 billion pkm or 13000 pkm per person (35 pkm per person and day) • of which car 79%, bus & coach 8%, air 7%, railway 6%, tram & metro 1%
Transport growth	Good transport: ca. 3% per year (1990-97), over 100% growth since 1970 Passenger transport: ca. 2% per year (1990-97), over 120% growth since 1970
Safety	Road: ca. 43400 persons killed (fatalities within 30 days) Rail: ca. 90 passengers killed in 1996
Environment	Share of emissions (man made) originating from transport: CO_2: 26% (29% if maritime bunkers are included) NOx: 63%w

Source: European Commission DG 07

Vision 11: Statistical Overview EU Transport

data for 1997, otherwise indicated

Memorandum
The Future of Work

"The recent great strides in technology present tremendous opportunities for human development – but achieving that potential de-pends on how technology is used." (UNDP(1999): Human Development Report 1999, p.57)

I. Globalization and New Technologies

Globalization and new technologies will have a major impact on the "Future of Work". Trends like liberalization and privatization influence future developments. New technologies will open new markets giving rise to new protagonists. As a result economic competition will change. National trading areas and labor markets will be integrated into the world market and exposed to international competition. Increasing international competition leads to a global shift of industries and jobs towards countries facilitating low production costs.

New information and communication technologies such as internet, mobile phones and satellite networks have shrunk space and time. Increasing productivity, falling costs and rapidly growing networks have transformed the computing and communication sector. These innovations and changes facilitate new forms of co-operation and work organization all over the world.

II. Co-operation and Work Organization

More and more multinational corporations emerge and spread their activities around the world. Fast and cheap means of communication, computer aided design and the standardization of tasks enable global players to co-ordinate and control their worldwide operations as a unit. At the same time flexible, small companies use network communication as a tremendous leveling force to compete – and succeed – in lucrative niches of the global market. New technologies, international co-operation and networking should lead to innovative concepts of work organization and new kinds of jobs. Engineers from all over the world should work together in Global Engineering Networks. Cross-functional teamwork of employees in marketing, purchasing, development or production in temporary projects should be realized more frequently.

Innovative information and communication technologies such as intranet and mobile communication systems support key processes. Co-operation in networks and "virtual companies" allow to overcome the traditional limits of time and place.

III. Education and Know-How Transfer

Knowledge and the ability for life-long self-reliant learning become even more important. Already more than half of the GDP in the major OECD countries is knowledge-based. People must be prepared for far-reaching changes in their work environment. Self-reliant continuous learning will be a key competence in future labor markets. The knowledge age requires technical, social and methodological skills. The integration of soft skills such as team-building, motivation and communication capacity should gain more importance. It should be clear that everyone is at the same time teacher and learner. New concepts and instruments of education e.g. distance learning through teleconferencing and, increasingly, the Internet spread critical knowledge all over the world. Continuous learning will become an attitude of life. Educational systems should focus on training people for self-reliant problem solving. One of the greatest challenges is to reduce the digital divide between industrial and developing countries.

IV. Employment Relationships

Employment and work as a purpose of life are major challenges of the 21st century. In the industrialized countries conditions in labor markets are changing. In addition to traditional productive work charitable work will gain importance.

For some people the vision of "Do your work where, when and with whom you want" might become true. New concepts of full and part-time employment and temporary work will arise. Self-employed people have to provide themselves for health care or old-age pensions.

Engineers should contribute to a growing consideration of human factors and help to establish better working conditions. Industrial safety should gain more importance. Especially psychological and mental strains should be controlled.

In the future the vision "work for everyone" even might become true. New technologies and growing markets enable people in developing and newly industrializing countries to participate in the growing wealth of nations.

V. Key factors for successful Performance

The effective use of new technologies and innovations as well as continuous learning will be key factors. Traditional organizations with hierarchical structures will be replaced by organizations delegating responsibility and allocating independent decision competencies. Team and project work will become more important. Fixed organizational structures and isolated performances will be replaced by fluid, permeable business processes varying with regard to suppliers, customers and the corporate structure. The virtual co-operation of various companies extends the present net product chains to networks. Despite large-scale co-operation the sector of research and development continues to be the core sector of most companies as it is a major factor for the future market success. Another factor for success is the creation of an atmosphere supporting innovations.

This can be achieved e.g. by suitable international patent laws and the support of research and pioneer projects. As a result of the growing importance of information technologies in daily living and working processes people depend more and more on these technologies. A framework that facilitates access and safety of people using these technologies will be a key factor, that determines the success of the New Economy in the future.

VI. Future Markets, Products and Services

Information and knowledge services are assumed to have high growth potential. They can either be product or process technologies and serve as a basis for the development of other key technologies. The range of products and services will be expanded. New virtual products open completely new fields of application: Cyber Economy, Cyber Community, Digital Workplace and Digital Household.

Products, systems and applications of information and communication technology will be merged into new services. As a result, new markets and business models in information and communication technology, mass media and entertainment (TIME) will emerge.

The knowledge society of the 21st century will be an economy mainly influenced by new information and communication technologies. Human capital and knowledge are highly important assets in this new economy. The effective use of information and communication technologies accelerates the development of newly industrializing or developing countries. The overall access to the world wide web is crucial to this process.

Memorandum
Energy

1. Challenges and measures

We energy engineers accept the challenge

- to provide – as a matter of priority – energy to the 2 billion people who up to now have not had access to the use of commercial energy and by doing so, to raise their living standards,
- to ensure that a growing world population – 8 billion people or more by 2025 – will be supplied with adequate energy services at affordable prices,
- to make every effort to ensure that the energy needed will be provided, distributed and used in a sustainable way, in terms of resources and the environment, and
- to develop and apply methods and procedures for energy conservation. For the purpose of sustainability especially industrial countries have to do the duty to reduce their energy demands and emissions in order to give developing countries the opportunity to satisfy their growing energy needs.

Our objectives are – in the absence of a simple solution – on a global basis

- to use a broad spectrum of all available energy sources,
- to make a variety of technologies for energy conversion and utilization available, and
- to realize the rational use of energy in extraction, transformation, transport and application.

As infrastructures, economic situations and social developments differ from country to country, the right combination of energy sources and technologies to be used will also have to differ. It is important, however, to maintain all available options on a long-term basis – knowing that a single energy source or technology cannot be an appropriate solution for all problems.

The measures to be taken to achieve these objectives must take into consideration both the supply side and the demand side.

It is our view that the most important measures and instruments are those which are suitable to improve the efficiency of energy production, distribution, transport and end use, and to develop additional energy sources such as renewable energy. This serves a dual purpose: the preservation of resources and the protection of the environment.

In order to meet the above mentioned challenges and objectives, it is necessary to advance the progress of research and development, focus on improving existing energy conversion and utilization technologies as well as developing new technological approaches, and also to promote energy conscious behavior in all areas through information and education.

2. Tasks

Energy Conservation

Every type of energy application that mankind can realize or conceive today has an ecological price. Energy simply cannot be used without stressing the environment, and that which differs is only the kind and the extent of this stress. Engineers should therefore pay greater attention to measures of energy conservation that – first and foremost – lead to a reduction of the worldwide primary energy demand.

Energy conservation means minimizing the cumulative energy demand of the entire chain, from the demand for energy services and the utilization of useful and final energy forms to the winning of the primary energies, under consideration of all relevant economic and ecological aspects.

In basic principle, energy conservation can be achieved by:

- promotion of energy-conscious behavior of the individual to avoid the production of non-utilized energy services,
- conscious changes of user behavior to achieve a rational adjustment of the demands made on the quantity and the quality of energy services,
- technical measures that will lower the specific energy requirements,
- energy technological measures that will raise energy efficiency,
- guaranteed energy supply at affordable prices.

Energy Conservation can only be achieved by:

- sufficiently detailed technical and economic expertise and sound knowledge and understanding of competing systems for similar services on the part of planners, producers, constructors and users, in order to ensure the best choice of technology and its dimensions from both the energy and the economic point of view,
- consideration of all investment, energy and other costs during the entire utilization period,
- comprehensive operating instructions and appropriate design of the control panels of instruments, plants and vehicles, which will ensure a rational use of energy.

Very closely linked with the problems of energy conservation are the material flows caused by mankind. Mining and recycling, and also material processing and manufacture, call for a considerable energy input and lead to a rapid reduction of the resources of the earth in the form of open material flows.

High-quality energy must therefore be used as a substitute for raw materials, and greater use must be made of material saving processes in energy supply, goods production and the rendering of services.

Fossil Energy Sources

Fossil fuels must continue to bear the main burden of assuring energy supplies over the next few decades. New and redeveloped technologies for increasing the efficiency of modern coal-fired and combined power stations and rational energy conversion can make contributions to climate control in the short and medium term. Integrated energy systems like combined heat and power plants can make a substantial contribution to improved use of primary energy and therefore to emission reductions. In the longer term, again, fuel cells could make a substantial improvement of the conversion chain.

Nuclear Energy Sources

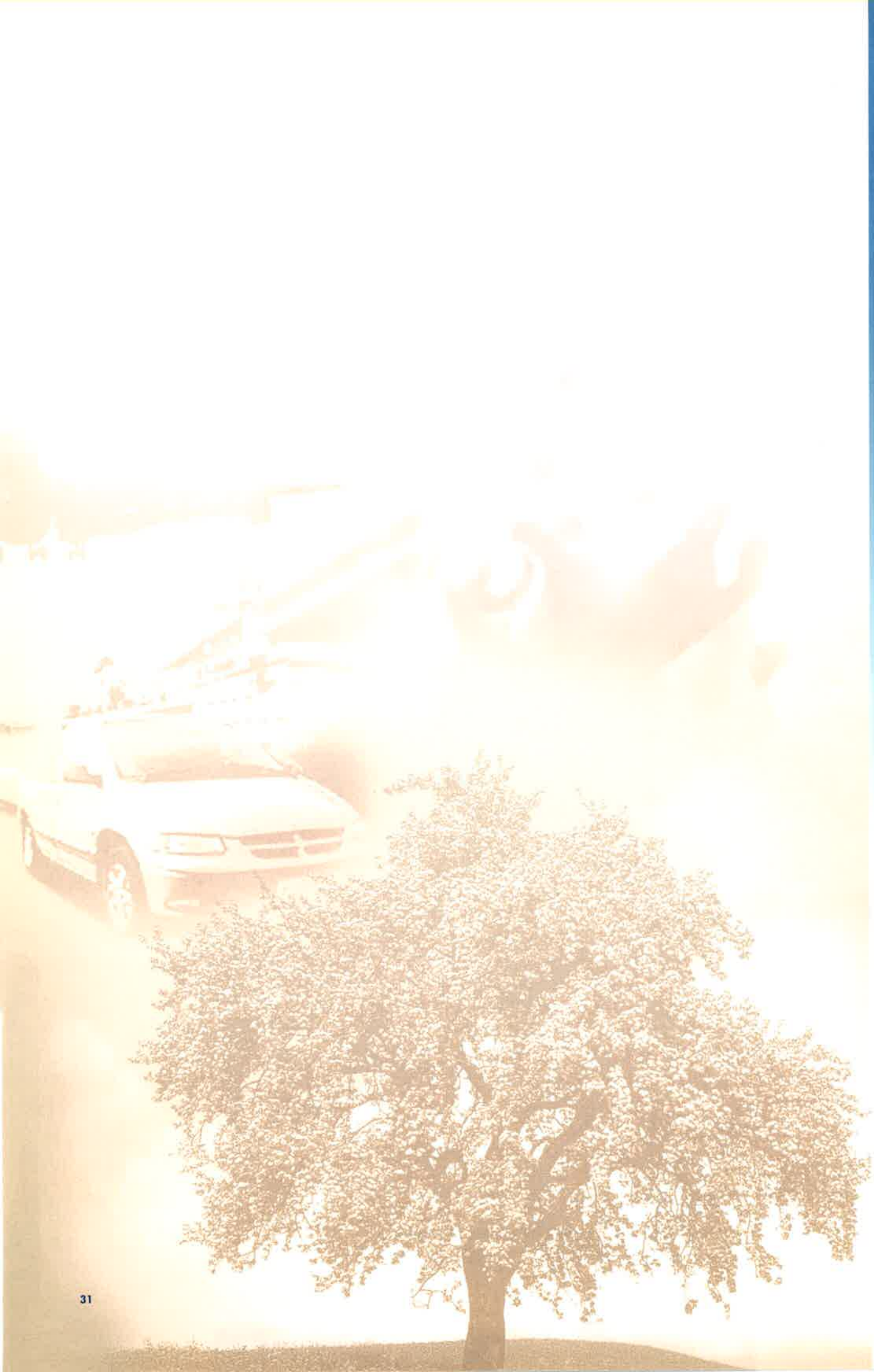
The utilization of nuclear energy is both ecologically and economically rational. This technology is being successfully operated and makes a resource-preserving contribution – associated with low costs and low emissions – towards meeting our growing energy requirements. Nuclear power use is being expanded worldwide. The level of safety is continually increasing due to the exchange of operating experience and engineering improvements in international collaboration. Therefore the abandonment of this technology can neither represent a national nor a global perspective.

The task of engineers consists of the further development of safety technology and the new development of reactors with inherent safety characteristics, the creation of a more economic operation of the power plants and the safe disposal of the waste products.

The use of nuclear energy contributes substantially to the reduction or stabilization of the greenhouse gas emissions. It is also a reasonable way for the world wide reduction of fissionable material of nuclear weapons.

Renewable Energy Sources

In the long term, renewable energy sources all over the world could make a substantial contribution to a sustainable energy supply, since they have a lot of ecological advantages and they are not exhaustible. With a view to assuring the future for mankind, we engineers are in favor of making greater use of renewable energy sources. In combination with energy conservation their development calls for a broad-based strategy for heat and power generation. In this connection, equal consideration must be given to advanced applied research, industrial research and development and market development. Market diffusion promotions should be organized and timed so as to make it possible to integrate innovations and lower costs. The essential characteristics of such programs would have to be continuity and reliability, and the programs would have to adhere to market standards by including quality assurance measures.



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