



Ministry of Education, Youth and Sports of the CR  
Research and Development Council

**PROPOSAL OF  
THE NATIONAL  
RESEARCH  
PROGRAMME**

2 0 0 2

Technology Foresight in the Czech Republic 2002



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## FOREWORD

In January 2000, the Government of the Czech Republic adopted the National Research and Development Policy of the Czech Republic. A substantial part of this strategic document represents the definition of the fundamental structure and function of the oriented research as a research oriented at support of the national economy development and at improvement of the quality of life of the population. The Ministry of Education, Youth and Sports of the Czech Republic was entrusted by the Government with preparing and commissioning a public tender for elaboration of a proposal of the National Research Programme (NRP) which should aim mainly at specifying selected priority research directions and proposing a process of the Programme implementation.

Based on the results of the tender, the Technology Centre AS CR in cooperation with the Engineering Academy of the CR were entrusted with preparation of the proposal of the National Research Programme and process of its implementation.

Though such a complex project had not yet been conducted in the Czech Republic all objectives were fulfilled in a relatively short period of 12 months. At the same time, quality supporting materials for preparation of the final proposal of the NRP for the governmental session in May 2002 were acquired. Assuming that the Government approves the proposal, a gradual implementation of the NRP into the existing system of research and development (R&D) support is expected from the beginning of 2003.

The major prerequisite for achieving relevant results was the initiation of a broad participation of professionals in the preparation of the proposal – several hundreds of top Czech scientists and researchers, industrial managers, managers of medical institutions, entrepreneurs and representatives of professional associations and industrial unions took part in it. It is necessary to appraise their intensive and strenuous work in panels and expert groups.

The staff of the Technology Centre AS CR and of the Engineering Academy of the CR who were co-ordinating and managing the project, deserve acknowledgement, too. Their cooperation with a panel of foreign experts, in which renown experts having experience with similar projects in their home countries were concentrated, was also an important contribution.

The economies of all developed countries profit particularly from newly acquired knowledge. A knowledge-based society is, thus, an important concept. Products, technologies and services, which are able to utilise the accumulated knowledge, should be able to succeed on global markets and should contribute to the fulfilment of social needs of the society. The identification of national priorities of research and development, followed by the concentration of public funds into the priority areas, creates conditions for successful use of knowledge also in the Czech Republic.

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## SUMMARY

This publication summarises the methodology and results of the project on preparation of the proposal of the National Research Programme (NRP) for the Czech Republic. This project is the first “technology foresight” exercise in the Czech Republic.

The main objective was to propose key research directions having strong potential to contribute to a favourable economic development and to the fulfilment of social needs of the society while optimally using the public funds for research and development. Simultaneously with the key research directions, a number of cross-cutting systematic measures were proposed which create conditions for the optimal functioning of the NRP. Elaboration of principles of the NRP management and the process of its implementation is also an important accomplishment of the project.

The proposed National Research Programme consists of 5 thematic programmes which are divided into 19 sub-programmes which include 90 key research directions. The NRP includes further 3 cross-cutting programmes which are divided into 19 cross-cutting sub-programmes (systematic measures).

Emerging technologies and market niches were also identified in the project. These are technologies highly regarded by experts from the point of view of their possible future market applications, and technologies through which the Czech Republic could penetrate into the international markets.

The results were achieved through a broad cooperation of several hundreds of leading representatives of research, industry, services, state administration and other organisations who worked in panels and expert groups.

The results of the project were a basis for the preparation of a final version of the proposal of the National Research Programme for the session of the Czech Government in May 2002. After the approval of the National Research Programme by the Government in the second half of 2002 preparatory work will be carried out, focused on gradual implementation of the NRP into the existing system of research and development support in the Czech Republic from January 2003.

Creation of a wide discussion forum of leading scientists, researchers, industrial managers, entrepreneurs, representatives of the state administration and other organisations is also an important consequence of the project. The potential of this expert group as a qualified forum of experts will be used in an appropriate manner in similar subsequent projects aimed at updating the selection of research priorities according to the development of economic and social needs of the country.

Detailed information on the results of the projects are given at [www.foresight.cz](http://www.foresight.cz).



## INTRODUCTION

The identification of strategically most important research directions, having a high potential to contribute to a favourable economic development and to the fulfilment of social needs of the society, together with the optimum utilisation of limited public funds, is the subject of many studies distinguished by their methodology, time horizon, envisaged applicability of identified priorities and also by the duration of the project and available financial means. Such projects are called “technology foresight”. A technology foresight includes both broadly oriented national projects analysing in detail the initial situation and resulting in the proposal of complex measures for the establishment of more favourable conditions for the acquisition and use of knowledge, and projects the orientation of which is narrower and aim e.g. at identifying priorities in a given field of the national economy and related research and development.

This publication summarises the results of the first technology foresight in the Czech Republic. The task of the project was to prepare a proposal of the National Research Programme<sup>1)</sup> and a process of its implementation in connection with the National Research and Development Policy of the Czech Republic, approved by the resolution of the Government of the Czech Republic on 5 January 2000.

The Ministry of Education, Youth and Sports of the Czech Republic which entrusted the Technology Centre AS CR together with the Engineering Academy of the CR with the project management, was the contracting authority/sponsor.

## OBJECTIVES

The objective of the project was in particular to propose priority research directions having a strong potential to contribute to a favourable economic development and to the fulfilment of social needs of the society while optimally utilising the public funds for research and development

The objectives were concentrated in two principal groups:

1. The proposal of the National Research Programme of the Czech Republic (NRP) consisting of the following tasks:

- a/ To specify the numbers, titles, objectives and characteristics of the main thematic and cross-cutting programmes of the NRP as stipulated by the National Research and Development Policy of the Czech Republic.
- b/ To propose sub-programmes (systematic measures) of individual thematic and cross-cutting programmes of the NRP.
- c/ To identify key research directions and allocate them to the sub-programmes.

2. The proposal of the process of realization of the National Research Programme of the Czech Republic (NRP) consisting of the following tasks:

- a/ To propose systems of organisation, management and supervision of the thematic and cross-cutting programmes.



- b/ To propose principles of competition for the financial support of projects from the NRP.
- c/ To propose a system of supervision and evaluation of projects supported from the NRP.
- d/ To propose basic principles of international cooperation.
- e/ To propose principles of the NRP financing.
- f/ To submit a framework proposal of the information system on the NRP realization.
- g/ To propose an appropriate procedure of the implementation of the proposal of the NRP.
- h/ To propose principles of communication with the public.

The first group of the objectives was attained through a combination of a number of steps which are described in more detail in the following section "Methodology". A special panel was established for the fulfilment of the second group of objectives.

## METHODOLOGY

### INITIAL CONDITIONS

The objectives and conditions of the project were the principal factors determining its methodology. The decisive base for the methodology were the following conditions, defined by the contracting party/sponsor<sup>2)</sup>:

- The results of the project must be achieved under a broad consensus of a wide spectrum of experts and relevant institutions.
- The sphere of knowledge production (research) and the sphere of its utilization (industry, health care, services) must equally participate in the preparation of the results of the project.
- The results of the project must stem from the needs of the society and from available research capacities and financial means.
- The results of the project must include information enabling, if necessary, to narrow down the selected research priorities during the preparation of the proposal of the NRP for the May 2002 session of the Government of the CR.

### METHODOLOGY

Available information on similar projects carried out abroad was used while preparing the methodology of the project. This information served as a basis for the creation of a methodology that corresponded to the objectives of the project and was suitable for the national environment. The resulting methodology was confronted with the opinions of the members of the international expert panel consisting of leading foreign experts, repeatedly participating in the management and implementation of projects of a similar type.

The project consisted of six consecutive phases:

- preparatory phase
  - establishment of the managerial, executive and advisory structure of the project;

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<sup>2)</sup> The Ministry of Education, Youth and Sports of the CR was the contracting party/sponsor of the project.



- collection of supporting documents for the work of panels
  - interviewing the application sphere;
  - acquisition of statistical data, information on the costs of research and development, and strategic ministerial conceptions for individual application sectors;
  - studies of external experts (external SWOT analyses of application sectors);
- work of panels:
  - identification of important and key research directions;
  - cross-cutting issues;
  - proposal of the NRP management and implementation;
  - final reports of panels
- tasks of the working group:
  - detailed proposal of the NRP structure and priorities;
  - final proposal of the NRP implementation and management principles
- final synthesis of results and preparation of the report for the contracting party/sponsor of the project;
- final conference and preparation of publications.

More detailed information on the methodology of the project is available at [www.foresight.cz](http://www.foresight.cz) where the final report of the project may be found.

## PANELS

The panels were the key component of the project. They comprised an average of 15–20 experts from particular branches. Each panel was managed by a chairperson who was assisted by a secretary of the panel. The latter was responsible also for the necessary administration including information flows. When establishing the panels the representation of both the research sphere (production of knowledge and innovations) and the consumer sphere (the utilisation of knowledge and innovations) were taken into account. The activity of panels resulted in the first place in justified proposals of priorities of individual thematic and cross-cutting programmes of the NRP in form of written reports which included the recommended key research directions (thematic panels) and related systematic measures (cross-cutting panels). A special panel was engaged in the elaboration of the proposal of the NRP management system and of the transfer of the existing programmes of oriented research into the new NRP.

For the needs of the project, 18 panels – 14 thematic, 3 cross-cutting and 1 systematic panel – were established:

### **Thematic panels**

1. Agriculture and Food
2. Environment
3. Health Care
4. Pharmaceuticals



5. Civil Engineering, Urbanism and Housing
6. Information Society
7. Materials and Technologies of their Production
8. Discrete Manufacturing and Products
9. Instruments and Devices
10. Machinery and Equipment
11. Chemical Products and Processes
12. Transport Systems
13. Power Engineering and Mineral Resources
14. Social Transformation

#### **Cross-cutting panels**

15. Human Resources for Research and Development
16. Integrated Research and Development
17. Regional and International Cooperation in Research and Development

#### **Systematic panel**

18. Management and Implementation of the National Research Programme

## SUMMARIES OF PANEL REPORTS

Results of the work of the 14 thematic panels include anticipated development trends in the CR to the year 2010, detailed SWOT analyses, proposed basic sets of key research directions (KRD) and possibly also recommended measures aimed at improving research and development utilisation.

Anticipated development trends were also specified by 3 cross-cutting panels, each of which also made a SWOT analysis of the issues handled by the panel and proposed appropriate systematic measures.

The panel engaged in the preparation of the proposal of the implementation and management of the NRP proposed a method of gradual conversion of the current system of the research support into the new Programme as well as main principles of its management and its financial and organisational backing.

Basic sets of key directions proposed by the panels were then further processed by the working group set up after the completion of the work of the panels. It comprised of the chairmen and secretaries of all the panels and other experts. The objective of the group was in particular to identify interdisciplinary research directions and to select those key research directions having the largest potential to contribute to a favourable economic and social development of the Czech Republic.

In this publication only selected results of the work of the panels and the subsequently established working group are mentioned. Detailed results of the project, the procedure of their achievement and further information are given at [www.foresight.cz](http://www.foresight.cz).





## THEMATIC PANEL AGRICULTURE AND FOOD

### EXPECTED TRENDS IN THE CZECH REPUBLIC IN THE NEXT 10 YEARS

- Reallocation and restructuring of agricultural production and parallel intensification and extensification.
- Development of technological procedures ensuring production of healthy and safe food while preserving quality of the environment.
- Growth of the share of non-traditional productions and use of agricultural production for the landscape formation and creation of attractive conditions for leisure time activities.
- Integration of the Czech agrarian sector into the European agrarian structures.

### PROPOSED KEY RESEARCH DIRECTIONS IN THE ORDER OF THEIR IMPORTANCE

1. Diagnostics, therapy and prevention of diseases of livestock, alimentary infections and zoonoses
2. Development of methods for the inspection of agricultural raw materials and food to ensure their quality and safety
3. Boosting competitiveness through the development of food of higher quality
4. Genetically modified organisms, their utilisation and risk assessment
5. Plant health
6. Development and technologies of food of a higher benefit
7. Genetic and biotechnological methods for improving biological potential of production organisms
8. Competitive production systems for multi-functional agriculture
9. Development of products and technologies for small-and medium-sized agricultural enterprises
10. Development of technologies for non-food use of agricultural raw materials utilising the production potential of agricultural plants
11. Effective management of livestock breeding
12. Innovation of technological processes for the processing of wastes from agricultural and food production with usable outputs
13. Landscape formation function of agriculture
14. Utilisation of biomass for power generation
15. Development of water treatment technologies
16. Development of information technologies and a new economy in the agrarian sector including food production
17. Economic prerequisites for the competitiveness of agricultural and food production
18. Protection and utilisation of natural resources and biological diversity of organisms in agriculture
19. Economic, structural, institutional and agrarian-political prerequisites for sustainable multi-functional agriculture
20. Development of energetically less demanding technologies in the agricultural and food production
21. Integration and rationalization of water and soil management in the landscape
22. Socio-economic, sociological and demographic conditions for maintenance and development of the countryside
23. Limitation of negative impacts of farming on the environment
24. Permanently sustainable forest management, production and non-production functions of forestry
25. Utilisation of wood raw material



## THEMATIC PANEL ENVIRONMENT

### EXPECTED TRENDS IN THE CZECH REPUBLIC IN THE NEXT 10 YEARS

- Expanding scientific discussion on key problems and methodology of their solution
- More attention will be paid to long-term effects of human activities on man and eco-systems
- Interconnection of environmental science and political agenda for a sustainable development
- Concentration of research on the study of interactions between the environment and man and on possible ways of directing this interaction to a sustainable trajectory

### PROPOSED KEY RESEARCH DIRECTIONS IN THE ORDER OF THEIR IMPORTANCE

1. Technologies for the environment
2. Interaction between man and environment
3. Sustainable transport
4. Protection of natural resources and material flows
5. Sustainable power engineering
6. Environment and health
7. Economic and social context of sustainable development
8. Sustainable agriculture
9. Man and landscape
10. Long-term ecological research – LTER



## THEMATIC PANEL HEALTH CARE

### EXPECTED TRENDS IN THE CZECH REPUBLIC IN THE NEXT 10 YEARS

- Inertial influence of trends of the last ten years: demographic changes, change of the way of life, identification of other risk factors of serious diseases, new diagnostic and therapeutic principles.
- Demographic changes: decrease of natality and prolongation of human life, ageing population.
- Change of the life style: decrease of consumption of food of animal origin and increase of consumption of fruit and vegetables, strategies for prevention of smoking, excessive alcohol consumption and drug addiction.
- Early identification of risk factors of serious chronic diseases, enabled by molecular genetic methods.
- Miniaturisation of instruments will lead to new diagnostic and therapeutic possibilities with targeted interventions directly on the site of specific organ defects.
- Development of information systems in medicine including the development of telemedicine with remote transfer of data of individual patients.
- Shortening of hospitalization, further transfer of diagnostics and treatment of a number of diseases into the ambulatory section, conversion of clinical departments of hospitals into nursing centres for chronically ill.

### PROPOSED KEY RESEARCH DIRECTIONS IN THE ORDER OF THEIR IMPORTANCE

1. Cellular biological and molecular biological aspects of health and diseases
2. Technological aspects of research in medicine (new materials, nanotechnologies, biological sensors, instrumentation in diagnostics and therapy), medicine informatics and telemedicine
3. Tumour diseases
4. Cardiovascular and cerebrovascular diseases
5. Diabetes mellitus, metabolic disorders, nutrition and endocrine diseases
6. Neurological and psychical diseases
7. Infectious diseases and immunity disorders
8. Injuries
9. Diseases of binders, bones and joints
10. Preventive approaches in health care
11. Health and its determinants including environmental factors
12. Social, economic and safety aspects of health care research
13. Age-specific aspects of health and disease



## THEMATIC PANEL PHARMACEUTICS

### EXPECTED TRENDS IN THE CZECH REPUBLIC IN THE NEXT 10 YEARS

- Development of new technologies applicable in pharmaceuticals – analysis of nucleus acids, biosensors, miniaturisation of analytical techniques – nanotechnologies and non-invasive analytical technologies.
- Development of diagnostics – in vitro diagnostics – clinical chemistry, immuno-diagnostics, microbiology, haematology/flow cytometry, coagulation, toxicology, serology, histology, radio-diagnostics, radio-pharmaceuticals and PET-pharmaceuticals, chiral aspects, proteomics.
- New biotechnologies will make it possible to prepare vaccines which will be cheaper and more easily and comfortably applicable than those currently used .
- Development of new polymeric bearers, enhancers of skin penetration, polymeric conjugates with medicaments, liposomal systems, systems with controlled release and various types of bearers including their analytical characteristics and proof of their safety.

### PROPOSED KEY RESEARCH DIRECTIONS IN THE ORDER OF THEIR IMPORTANCE

1. Gene therapy
2. New biotechnological procedures in pharmaceuticals
3. Preparation and characterisation of new substances
4. Mechanisms of action of medicaments and their fate in organism
5. New medicament forms and directed distribution in organism
6. Immune-modulation and anti-inflammatory medicaments
7. Anti-tumour medicaments based on new principles of action
8. Anti-microbial, anti-virus and anti-mycotic medicaments
9. Diagnostics, radio-pharmaceuticals – development of diagnostics procedures and means
10. Phyto-pharmaceuticals and nutritional supplements in the prevention and protection of health against chronic diseases
11. Pharmacological economics and pharmacological informatics



## THEMATIC PANEL CIVIL ENGINEERING, URBANISM AND HOUSING

### EXPECTED TRENDS IN THE CZECH REPUBLIC IN THE NEXT 10 YEARS

- Impact of the accession of the CR to the EU – construction of high-ways network, roads and railroad corridors, provision of modern civic facilities, housing, building of a modern industrial base, trade, tourism and ensuring ecological friendliness of all human activities.
- Growth of housing on the basis of mortgages and guarantee function of the state housing fund and establishment of a transport infrastructure fund as a guarantor for the development of transport structures.
- Development of civil engineering, particularly transport, water and ecological structures.
- Harmonisation of products and standards, technologies, education, legislation and implementation of business classification after the accession to the EU.

### PROPOSED KEY RESEARCH DIRECTIONS IN THE ORDER OF THEIR IMPORTANCE

1. Research and development of new materials, improvement of characteristics of the existing ones, prediction and detection of material properties
2. Research and development of new technologies for supporting structures and their foundation
3. Development of methods for the optimisation of materials and constructions including the enhancement of reliability and durability of structures
4. Optimisation of energy intensiveness of materials, constructions and their operation using alternative sources, design of structures with intelligent behaviour and response
5. Minimisation of negative impacts of building activities and structures from the point of view of sustainable development
6. Ground communications of a new generation
7. Optimisation of structures from the point of view of price and their use qualities
8. Underground urbanism and solutions to the infrastructure of large cities and agglomerations (city engineering)



## THEMATIC PANEL INFORMATION SOCIETY

### EXPECTED TRENDS IN THE CZECH REPUBLIC IN THE NEXT 10 YEARS

- Commercial use of research results will proceed at two levels:
  - in form of export of know-how and software products with extremely high added value without above-average requirements for raw material resources and energy;
  - in form of cooperation with strong foreign partners (strategic investors) who will enter production enterprises and build software houses or technology centres.
- Introduction of production of electronic parts and systems, transmitters, hardware for embedded applications, hardware for wireless communication and subsystems of man-machine interaction.
- Development of networks and communication means, surface use of GRID type networks (or higher in quality) will be common in the horizon of 10 years.
- The CR will preserve its good level of mobile communication.
- Competitiveness of the European environment will exert pressure on the transfer to digital television and terrestrial services provided by means of it, particularly in the area of larger, sophisticated information systems of state administration and health care.
- Personal chip card will become commonplace in the horizon of 10 years.

### PROPOSED KEY RESEARCH DIRECTIONS IN THE ORDER OF THEIR IMPORTANCE

1. Systems for automatic control and data acquisition
2. Means of mathematical and computer modelling, simulation of systems and multi-media presentation of solutions
3. Sophisticated integrated circuits and systems, modelling and description including complex systems on a single chip
4. Design, implementation and application of large-scale computing, database and information systems
5. Artificial intelligence and its applications
6. Medical information and knowledge-based systems including personal systems
7. Development of sensors, actuators and means for interactive man-machine communication
8. Electronic documentation in the systems of health care, social security etc.
9. Multifunctional communication networks including safety and protection of data
10. Digital television and radio, providing interactive information services by exploring digital terrestrial television
11. Research and development of semi-conductors from the point of view of reliability, diagnostics of materials and their defects



## THEMATIC PANEL MATERIALS AND TECHNOLOGIES OF THEIR PRODUCTION

### EXPECTED TRENDS IN THE CZECH REPUBLIC IN THE NEXT 10 YEARS

- Gradual development may be expected in all principal metal and non-metal materials.
- Intensive growth of production and applications is anticipated particularly in the field of plastic materials and polymers, semi-conductors and advanced ceramics.
- Strengthening concentration on nanomaterials and nanotechnologies, intelligent materials and systems, biotechnologies and biomaterials and on developing entirely new principles of mass production of materials and products.
- Increased interest in recyclable materials and materials friendly to the environment .

### PROPOSED KEY RESEARCH DIRECTIONS IN THE ORDER OF THEIR IMPORTANCE

1. Nanotechnologies and nanomaterials
2. Intelligent materials and structures
3. Technical polymers and their composites
4. Advanced ceramic materials
5. Materials for biomedical applications
6. Materials of a high strength/density ratio
7. Surface engineering
8. Materials for high temperatures and pressures
9. Electronic and photonic materials and structures
10. Advanced steels and related technologies
11. Degradation of materials, its restriction and control
12. Textile materials and their technologies
13. Inorganic glasses and their technologies
14. Modelling in material engineering



## THEMATIC PANEL DISCRETE MANUFACTURING AND PRODUCTS

### EXPECTED TRENDS IN THE CZECH REPUBLIC IN THE NEXT 10 YEARS

- Industry is expected to increase its pressure on introduction of new materials, products and technologies practically in all sectors.
- Increased demand on a decrease in material intensiveness, decrease in weight of products; composite and egg-shell constructions will be gaining ground.
- Permanently growing requirements for quality (certification); importance of new measuring and testing technologies using metrology and continuous diagnostics will increase.
- Increasing demands for cleaner production and overall decrease of pressure on the environment.
- Development of production branches based on local raw material resources (renewable if possible) and local power sources.
- Decrease of energy intensiveness of production processes, increasing demands on recycling and wasteless technologies.
- Development of production processes using information technologies and broad application of software engineering, application of control systems and optimisation of production processes.
- High automation will become the principal prerequisite for preservation and development of traditional branches.
- Decrease of the share of “heavy” production branches in the CR and increase of production branches in the sector of consumer industry.

### PROPOSED KEY RESEARCH DIRECTIONS IN THE ORDER OF THEIR IMPORTANCE

1. Software engineering
2. Machining/tooling technologies
3. Technologies of welding, soldering and thermal cutting of materials
4. Increase of utility features and decrease of ecological impacts of products of new metal-based materials
5. Production automation, methods and algorithms of measurement and control processes
6. Processing of secondary raw materials and recycling of waste materials from industrial and other production processes
7. Glued joints of construction materials and development of new types of adhesives for material jointing
8. Mechatronics
9. Development, production and bonding of composites
10. Surface treatment and its technologies
11. Chipless technologies (foundry and forming technologies)
12. Special inorganic materials and technology of their production
13. Development of testing methods for product quality verification and supervision of production technologies
14. New processing technologies – rationalisation of production processes of building materials and products





## THEMATIC PANEL INSTRUMENTS AND DEVICES

### EXPECTED TRENDS IN THE CZECH REPUBLIC IN THE NEXT 10 YEARS

Significant growth and market interest in the instrumentation products may be shortly expected particularly in the following segments:

- Instruments and systems for diagnostics and therapy particularly in the field of oncological and cardiovascular diseases, including the supporting software equipment;
- Instruments and equipment for optical communication and sensor technique using integrated optical and fibre wave-guides and equipment based on the principles of quantum and statistical optics;
- Instruments and equipment for micro- and nanotechnologies (creation and examination of micro- and nanostructures);
- Systems for monitoring the environment, and their components;
- Instruments and equipment related to power saving, and their components;
- Instruments and systems for industrial diagnostics, and their components (including supporting software equipment);
- Modular systems and instruments on the basis of universal modules with standardised interface in which the functions of the instrument are defined by the software and realised by digital processing of a signal (so-called virtual instrumentation);
- Instruments and equipment for biotechnologies, and their components.

### PROPOSED KEY RESEARCH DIRECTIONS IN THE ORDER OF THEIR IMPORTANCE

1. Instruments for creating micro- and nanostructures using electron and ion beams and x-ray radiation and instruments for morphological, analytical and structural examination of natural and purpose-created micro- and nanostructures
2. Optical elements, micro-layers, nano-layers and technologies for instrumentation
3. Instruments and equipment based on the principles of quantum, statistical and wave optics, including instruments and equipment for optical communication
4. Instruments for diagnostics of cardio-vascular diseases
5. Instruments for diagnostics and therapy of oncological diseases (including the instruments on the basis of particle and electromagnetic radiation)
6. Display systems for diagnostics and their use in therapy including processing and analysis of visual data
7. Instruments and systems on the basis of modules with standardised interfaces
8. Instruments and systems for monitoring the environment
9. Electromagnetic compatibility of instruments and systems
10. Software and technical modules for instrument control and data analysis
11. Instruments for industrial diagnostics
12. Switching processes and new materials for switching mechanisms of electrical instruments
13. Manipulators for immobile persons and biomechanical substitutes
14. Systems for over-voltage protection



## THEMATIC PANEL MACHINERY AND EQUIPMENT

### EXPECTED TRENDS IN THE CZECH REPUBLIC IN THE NEXT 10 YEARS

The overall characteristics of trends in the sphere of machinery and equipment in the CR to the year 2010:

- Large-scale serial production in large firms with foreign capital participation;
- Special-purpose components as sub-supplies for supranational final production;
- Large- and medium-sized companies develop in symbiosis; establishment and increasing number of large supranational companies with strong capital background may be expected to which smaller companies producing flexible and economically favourable sub-supplies will establish business connections;
- Machines and equipment of special or special-purpose types;
- Machines and equipment produced in small series;
- Unique machines and equipment;
- Machines and equipment of modular conception assembled from top-quality functional components.

Portfolio of products of a special, unique, special-purpose character (products of a high added value) will constitute an important sphere of activities of small- and medium-sized companies.

### PROPOSED KEY RESEARCH DIRECTIONS IN THE ORDER OF THEIR IMPORTANCE

1. New principles of elements, mechanisms of machinery, and equipment of a higher use value
2. Methods of designing and experimental research of machinery structures and their components
3. Machinery and equipment of a new generation with advanced top-quality components
4. Machinery and equipment for permanently sustainable mobility of persons and cargoes
5. Machinery and equipment for power generation respecting permanently sustainable development
6. Machinery and equipment for the protection and improvement of the environment



## THEMATIC PANEL CHEMICAL PRODUCTS AND PROCESSES

### EXPECTED TRENDS IN THE CZECH REPUBLIC IN THE NEXT 10 YEARS

The panel specified the following trends:

- The amount of processed crude oil will increase by 20–30%;
- Production of polymers and elastomers will increase by 50–60%;
- Production of rubber and plastics industry will increase by 50%;
- Production of basic chemical substances will expand;
- Production of fertilisers will expand;
- Development of resins and coatings under an increased use of the existing capacities is desirable;
- Development of production of more complex organic chemicals is expected;
- By the year 2004 the investments in crude oil processing and in primary petrol chemistry will have been completed and further remarkable development in this sphere cannot be expected by the year 2010;
- New investments should be built in the areas of existing large chemical plants in order to reduce transport costs, to make the maintenance more effective and to decrease the impact of chemical processes on the environment;
- Product range will narrow and in case of specialised products the capacities and share on the European market will increase, some productions will cease to exist;
- Strong foreign companies involved in chemistry will enter chemical companies as owners and thus the markets will open and the entrepreneurial atmosphere will improve;
- Specialisation of chemical research;
- Increase of the share of research costs of total turnover;
- Improvement of corporate culture and improvement of working conditions .

### PROPOSED KEY RESEARCH DIRECTIONS IN THE ORDER OF THEIR IMPORTANCE

1. Catalytic processes
2. Chemical material research
3. Organic syntheses for more sophisticated products
4. Process and chemical engineering
5. Nanotechnologies
6. Technologies of plastics processing and waste recycling
7. Chemical ecological research
8. Utilization of domestic raw material base



## THEMATIC PANEL TRANSPORT SYSTEM

### EXPECTED TRENDS IN THE CZECH REPUBLIC IN THE NEXT 10 YEARS

In the coming period substantial changes can be expected in the national economy which will involve also transport systems of the country. The anticipated accession of the CR to the EU that will principally influence the national economy as well as both the internal and external transport relations, activities and systems, is one of the most important circumstances. Structural changes of industry and entry of foreign capital, together with changes in agricultural policy and the common market, will influence the demands on the transport systems, particularly in freight transport. In passenger transport, the expected mobility of labour force, the necessity of further preference of public transport at the expense of individual transport and the increase of demands on business and recreation trips will be of substantial importance. From that the most important strategic goals in the sphere of transport ensue:

- development of the transport infrastructure in the context of the European infrastructure;
- securing conditions for functioning of the internal market while harmonising the conditions and maintaining internal and foreign competition;
- effective contribution to permanently sustainable growth of mobility while ensuring full transport availability;
- ensuring increased transport safety.

### PROPOSED KEY RESEARCH DIRECTIONS IN THE ORDER OF THEIR IMPORTANCE

1. Development of transport telematics and intelligent transport systems
2. Improvement of public transport and development of integrated passenger transport systems
3. Improvement of technical conditions, modernisation of transport infrastructure and means of transport
4. Decrease of negative impacts of transport on the environment, increase of safety, decrease of the accident rate
5. Development of transport systems on the principles of permanently sustainable mobility and availability
6. New methods and tools for financing the development of transport networks and services



## THEMATIC PANEL POWER ENGINEERING AND MINERAL RESOURCES

### EXPECTED TRENDS IN THE CZECH REPUBLIC IN THE NEXT 10 YEARS

- Synergy of coal and nucleus defines the long-term development trajectory of Czech power engineering.
- Coal will be an important competitive power and non-power-producing source in the CR during the whole first half of the 21st century.
- The efforts to maintain and improve the quality of traditional raw materials, implementation of standardisation of their characteristics, growing consumer pressure on the improvement of quality and extension of the product range will be the prevailing trends in processing non-ore raw materials in the CR.
- The wastes, the power-producing use of which in the CR is still on a low level, will be included into the raw materials resources in a greater extent.
- Development of the economy will result in a moderate pace of the growth of power consumption.
- A number of changes may be expected in the utilization of natural gas, both institutional (continuing privatisation and liberalisation of the market) and factual, particularly the extension of domestic resources.
- Appropriate methods of exploitation of coal methane and development of new technologies of its use (fuel cells, co-generation, fuel of motor vehicles, chemical use) will be developed.
- The share of energy produced from renewable sources in the CR, particularly biomass, small water power stations, geothermal and sun energy, will increase.
- Crude oil will remain the basic petrochemical raw material.
- Consumption of fuels and pressure on the state administration to improve conditions for air and water protection will increase.
- Consumption of biologically degradable fuels will increase.

### PROPOSED KEY RESEARCH DIRECTIONS IN THE ORDER OF THEIR IMPORTANCE

1. Nuclear power engineering
2. Securing nuclear safety and reliability during the whole operating time of a nuclear power plant
3. Assuring long-term operation time of a nuclear power plant
4. Processing of coal using clean technologies
5. Coal as a power producing raw material
6. Power engineering using fossil fuels
7. Increasing operation effectiveness of existing nuclear power plants
8. Research on the possibilities of more extensive use of wastes from the extraction and processing of mineral raw materials, development of low-waste treatment technologies
9. Effective expansion of a combined production of power and heat and reliability of power producing systems
10. Treatment of radioactive wastes and irradiated nuclear fuel and management of the end of the fuel cycle in nuclear power plants
11. Use of methane bound in coal deposits
12. Providing for complex exploitation of coal substance
13. Development of new nuclear power engineering technologies
14. More extensive use of non-ore raw materials for materials with a broad range of application
15. Rational use of crude oil
16. Use of renewable power producing sources



## THEMATIC PANEL SOCIAL TRANSFORMATION

### EXPECTED TRENDS IN THE CZECH REPUBLIC IN THE NEXT 10 YEARS

#### Trends in the political system:

- Completion of interactions between individual institutions and various levels of the political system.
- Completion of reforms aimed at institutional decentralisation of power and growth of the power of local and regional policy
- Strengthening of the role of the civic sector in the process of political will formation and growing emphasis on the obligation of politicians to publicly account for their activities.
- Increase of influence of associations of citizens and non-governmental organisations on the life of the society.
- Discussion on the legitimacy of EU political bodies and enforcement of national and regional interests in the agendas of political panels of the EU.
- Possibility of increased demonstrations of political radicalism and extremism.

#### Trends in the economic system:

- The Czech Republic will be under multilateral pressure to further modernise the structure of the Czech economy sectors, their technological equipment and related institutional environment.
- Pressure on the competitiveness of the Czech economy will increase.
- Understanding of the concepts of labour, labour market, employment and flexibility of labour force will change.
- Growth of the demand for flexible labour force – working hours and employment time, adaptability to repeated changes of working requirements.
- Demand for so-called symbolical analysts, particularly in the sphere of services: education, media, specialised guidance and consultancy, marketing, Internet services and law will increase.
- Czech economy will be under growing pressure of its own externalities: shortage of raw materials and ecological consequences of economic activities.

#### Trends in the legal system:

- Increased pressure on a clear establishment of mechanisms of a legal state and encouragement of legal awareness.
- Pressure on various kinds of legal and arbitrage settlement of disputes on various levels and in various spheres of life will increase.
- Reform of the public administration from the legal, geographical, political and economic points of view.

#### Trends in the social system:

- Change of social stratification of the Czech society as a consequence of enforcement of social stratification mechanisms.
- Social stratification will result in other mechanisms of social exclusion and social inclusion, the character of poverty will change and social solidarity and social policy will be redefined.



- Currently oscillating demographic trends will settle and major effects of the second demographic change will manifest themselves: decline in the number of inhabitants, plural approach to partner cohabitation and ageing of the population.
- Mechanisms of social integration and disintegration will change.
- Material standard of living will increase, value patterns and consumption structure will change.
- In compliance with the development of knowledge-based and information society, the Czech education system will be further transformed, the number of students of tertiary education will increase and lifetime education will become the standard.

#### Trends in the system of culture:

- Value structures will change – increasing differentiation of the society (social, ethnic, generally cultural) will press on the acceptance of plurality of opinions.
- The nature of national awareness and national identity will change in the context of parallel processes of internal decentralisation and international integration.
- The meaning of life strategic planning will increase and the demands on the provision of scientifically produced information will increase.
- Expectations towards science and research from the side of economic, political, public and other institutionalised actors will increase.
- In the sphere of human sciences and arts, various scientific paradigms will overlap.
- The definition of the quality of life with respect to various types of individual social actors will change.

#### **PROPOSED KEY RESEARCH DIRECTIONS IN THE ORDER OF THEIR IMPORTANCE**

In the economic, legal, political and security sphere – under the global title “Performance-oriented, safe and European-integrated society”.

1. Economic performance and market relations – social, political and ecological implications.
2. Formation and stabilisation of the political and legal institutional framework.
3. International integration and globalisation – political, economic, social and cultural aspects.

In the social and cultural sphere under the global title “Social cohesion, social differentiation and national identity”.

1. Social, cultural and regional cohesion in a differentiated society.
2. Open society: social and cultural adaptability.
3. Knowledge-based society and new forms of education.
4. Conditions and effects of population reproduction and demographic ageing in the process of modernisation of the society.



## CROSS-CUTTING PANEL HUMAN RESOURCES FOR RESEARCH AND DEVELOPMENT

### EXPECTED TRENDS IN THE CZECH REPUBLIC IN THE NEXT 10 YEARS

- Slight increase in the sphere of human resources capacity (number of workers) for research and development will be achieved.
- Substantial decrease of labour force in productive age will result in a certain tension on the labour market.
- The solution will not consist in a quantitative growth of human resources, but rather in the achievement of a qualitative change in this sphere, particularly in the preparation of new experts and in the process of development and mainly utilization of the qualification of already active scientists and researchers.

### PROPOSED SYSTEMATIC MEASURES

1. To transform the existing structure of human resources into a highly mobile and flexible base through meeting new demands and stimulating formation of new internal structures capable of being further innovated.
2. To convert scientific institutions into organisations based on democratically created networks of relations and behaviour of the individuals and groups of scientists.
3. To open supporting social programmes for young and younger scientists and to enrich, thus, the development of science in the CR besides its thematic and material dimension also by its social aspect.





## CROSS-SECTIONAL PANEL INTEGRATED RESEARCH AND DEVELOPMENT

### EXPECTED TRENDS IN THE CZECH REPUBLIC IN THE NEXT 10 YEARS

- The situation in education, research and development will be substantially influenced by the accession of the CR to the EU and by the ongoing globalisation.
- Proposed restriction of mobility of labour force of new EU member states will not affect highly qualified labour force and particularly research workers. It will result in an increased pressure on those workers to leave for abroad. At the same time, our country will become more attractive for highly qualified workers from non-member EU countries.
- Students of universities and colleges will be increasingly aware of their position as clients (irrespective of the methods of financing the study) and will require a system of education similar to European universities that would ensure them as good as possible position in the labour market. The system of education will adapt to these trends.
- Concentration of research into selected “centres of excellence”, their interconnection and further development of interdisciplinary sphere will take place. Not only supranational research centres will be established but more stress will be laid on the solution to larger and more complex projects also at the regional level.
- As a counter-balance to globalisation “regionalisation” will manifest itself through scientific centres, particularly universities and colleges, being more involved in the issues of their regions – the economic development and the resulting quality of life.
- In organising development processes, methods of project management will be used more extensively and economic-marketing procedures will be integrated.
- An effort to create so-called “clusters” – formation of networks of enterprises and research centres capable of realising even large-scale projects – will be more obvious. At the same time the system of financing will change towards the support of large-scale, often interdisciplinary projects at the expense of fragmentary tasks of individual workplaces.
- The development will lead to creating a “knowledge-based society”.

### PROPOSED SYSTEMATIC MEASURES

1. Adoption of the principles of the innovation policy of the CR
2. Creation of a suitable legal framework for the development of research and industry cooperation
3. Support of the integration of research and development
4. Analysis of the existing activities of research centres
5. Creation of a legal framework for intellectual property rights
6. Support of the partnership of public and private sectors
7. Support of the participation of small enterprises in innovation processes
8. Support of the establishment of funds for setting up technologically oriented companies
9. Support of the development of human resources
10. Improvement of research evaluation
11. Assurance of the co-ordination of the above-mentioned activities



## CROSS-SECTIONAL PANEL REGIONAL AND INTERNATIONAL COOPERATION IN RESEARCH AND DEVELOPMENT

### EXPECTED TRENDS IN THE CZECH REPUBLIC IN THE NEXT 10 YEARS

- In the interest of increased competitiveness, the role of education, particularly lifetime, will strengthen, and the pressure on social and economic influence of universities and colleges in the regions will increase.
- Economic growth will be based more on innovations, while the driving force of these changes should be qualitatively higher form of cooperation between universities and industry, particularly small innovation companies.
- The activity of innovation companies will complement large-scale industry led by globally acting companies characterised by globalised research and development.
- Regional approaches towards economic growth will be based on the revival of traditional branches and on the support of new industrial branches – for both it is necessary to improve the relations between industry and research and development:
  - through creating high-tech clusters;
  - through supporting innovation start-up companies (research spin-off).
- Global economy will newly form relations between supranational companies, top universities and research centres.
- The restriction of mobility of Czech workers in the European area will not affect outstanding young talents. The demand for them will increase and, thus, the “brain drain” will intensify.
- The trend of low interest of younger generation in technical branches will persist.
- Creation of the European research and education area will aim at utilizing unique laboratory techniques and instrumentation.
- Mobility of educated workers from non-European countries, particularly from Asia, will increase.

### PROPOSED SYSTEMATIC MEASURES

#### Regional cooperation:

1. Support of cooperation between weak and strong regions in research and development
2. Support of research, development and innovation transfer to weak regions
3. Boosting research and development capacities of weak regions

#### International cooperation:

1. Support of participation of research and development entities in international projects, according to the criterion of added value
2. Support of involvement of local research and development in the European Research Area (ERA)



## PANEL MANAGEMENT AND IMPLEMENTATION OF THE NATIONAL RESEARCH PROGRAMME

The objective of the panel was to elaborate optional proposals of the NRP management, system of related realization principles and recommendations and a procedure of its implementation into the existing system of support of research and development in the CR. The proposal is based on relevant economic, technical and international factors that will influence the realization of the programme in the coming five years.

The results of the work of the panel given in the final report are extensive and are completed with a number of annexes. A concise overview of the principal results and recommendations include the following topics:

- The NRP management is elaborated in two options:
  - centralised management with a single AUTHORITY<sup>3)</sup>;
  - decentralised management in which apart from the AUTHORITY more subjects (ministries, official administrative bodies) participate in the NRP management .

The panel recommended the centralised management as the target situation.

- Proposal of principles of a public tender in research and development, including a proposal of the rules of procedure of expert advisory bodies.
- System of evaluation and supervision of the NRP, its programmes and individual projects and description of the supervision.
- Principles of international cooperation.
- Financing, including a draft of the contract on the provision of support and a draft of the decision on the provision of the support.
- Information system of the NRP and communication with the public is proposed as a system encouraging preparation of project proposals and giving guidelines for their evaluation and decision-making. This system is based on the existing information system of research and development of the Research and Development Council. The proposal of the information system has been elaborated in several options.
- The implementation of the NRP is proposed in three options and it is in compliance with the draft of the law on research and development under preparation. The most probable option is a gradual launching of the NRP through newly opened programmes and projects depending on available financial means.

The final detailed version of the management and implementation of the NRP will be the result of negotiations between ministries following the panel work and will take place in the second half of 2002.



## STRATEGIC KEY TECHNOLOGIES

Some of the panels have also identified emerging technologies and market niches. These are technologies, considered to be highly perspective from the point of view of their future market application, or technologies through which the Czech republic might, according to the experts' opinion, establish itself on the international market.

Successful application of these strategic key technologies is subject to the support for corresponding research directions. Strategic key technologies mentioned in the following table are described in the final reports of the panels in more detail.

Panel	Strategic key technologies
<b>Pharmaceutics</b>	<ul style="list-style-type: none"> <li>• Chiral aspects of the preparation and study of biological effects of medicaments (relations between the asymmetry of molecules of medicaments and their biological effect) – preparation and characterisation of new medicaments, mechanisms of their action and their fate in the organism</li> <li>• Biotechnologies – new biotechnological procedures in pharmaceutics (based on molecular genetics methods), gene therapy</li> <li>• Nanotechnologies – preparation and characteristics of new substances, gene therapy methods resulting from gene engineering methods</li> <li>• Drug targeting – targeted distribution of medicaments in organism, controlled transport and release</li> </ul>
<b>Information society</b>	<ul style="list-style-type: none"> <li>• Tools for modelling and simulation including systems of virtual reality</li> <li>• Embedded applications consisting of hardware and software solutions on a single chip</li> <li>• Development of software tools for automated testing of software systems and components</li> <li>• Software systems on the basis of cryptic techniques for the needs of transfer protection and security</li> <li>• Software tools supporting the activity of virtual enterprises – integrating systems of e-trade, tools of knowledge-based management, database systems and data stores</li> <li>• Mutual interconnections between different systems using wireless communication – to integrate the networks for mobile communication with e.g. GPS, GPRS, with technologies for local data collection, e.g. Bluetooth, autonomous control and diagnostic systems</li> </ul>



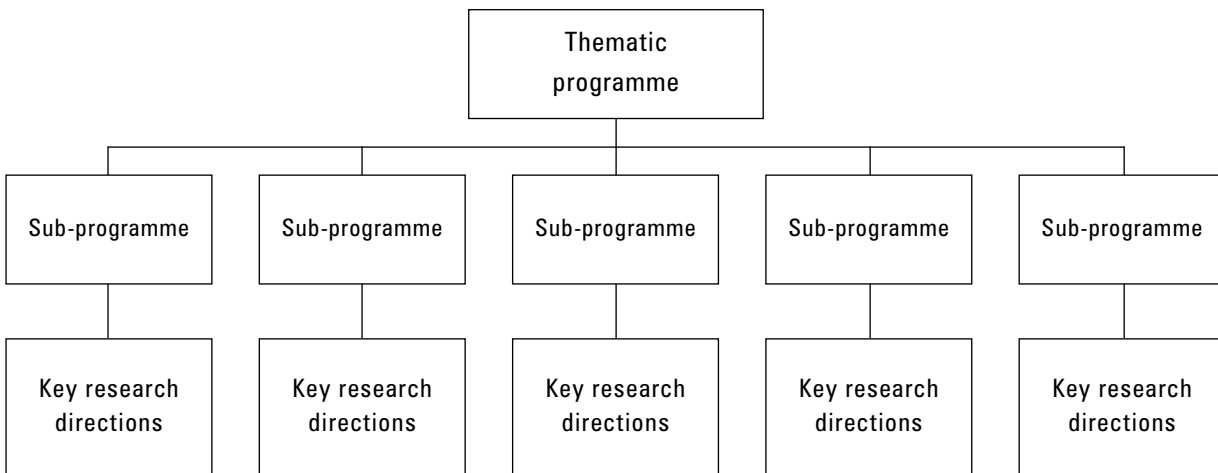
<b>Materials and technologies of their production</b>	<ul style="list-style-type: none"><li>• Nanotechnologies – aimed at controlling material structure (both organic and inorganic) in nanodimensions and utilizing completely new phenomena in electronics, chemistry, medicine and pharmaceuticals, power engineering, mechanical engineering etc.</li><li>• Intelligent materials – materials having the natural ability to actively react to external impulses by changing their characteristics. Application in a number of branches – sensors, information technologies, mechanical engineering, building industry, security, armed forces, medicine etc.</li><li>• Production technology of products or semi-finished products without further machining (near-net shape technologies) – modern technologies increasing productivity, particularly of the engineering production (powder metallurgy, shaping in semi-liquid state, hydroforming etc.)</li><li>• Materials for fuel cells which are a perspective ecological power source, particularly for mobile applications</li></ul>
<b>Instruments and Devices</b>	<ul style="list-style-type: none"><li>• Raster electron microscope for schools and industrial control</li><li>• Non-selective environment analyser based on the principle of a weight spectrometer M 1-50</li><li>• Portable element analyser on the principle of RTG fluorescent spectrometer</li></ul>
<b>Chemical products and processes</b>	<ul style="list-style-type: none"><li>• Processing and recycling plastics, particularly products of a higher added value, in order to increase the export of products of plastic materials and to cover domestic demand; domestic sources of polymers and the possibility of building new production capacities in the regions having high rate of unemployment are of advantage.</li><li>• Nanotechnologies – synthesis of thin organic layers (material protection, medicinal compatibility, membranes, composites), preparation of new skeletons of polymers (supramolecular chemistry). Application areas – external polymer parts of the automobile body, coatings, barrier packaging, cosmetics, waste water treatment, catalysts, abrasion resistant coats of machine parts, lubricants of a new generation, plasma coating of very thin compact layers, nanosensors for implantation into the human body, self-disinfecting sanitary ceramics, parts of computers of a new generation, electroceramics, new types of solar cells and batteries, new materials for microelectronics and optics, biocatalysts and membranes for medicine.</li></ul>
<b>Transport systems</b>	<ul style="list-style-type: none"><li>• Telematic systems in transport, development of intelligent transport systems using telecommunication technologies, of sophisticated information systems and implementation of logistic technologies</li><li>• Logistic methods and technologies, including citylogistics, optimisation of methods for allocation of logistic centres in serviced regions</li><li>• Electronic control, security, monitoring and navigation systems</li><li>• Flight diagnostic systems, components and products for integrated railway and city public and regional transport</li><li>• Hydrogen fuel, production and storage of hydrogen</li></ul>
<b>Power engineering and mineral resources</b>	<ul style="list-style-type: none"><li>• Use of methane bound in coal deposits with the aim to develop a modified extraction procedure enabling to use domestic resources of coal methane. Utilization of these supplies would permit to lower the natural gas import for several decades and diversify, thus further, the sources of primary power producing raw materials in the CR.</li></ul>



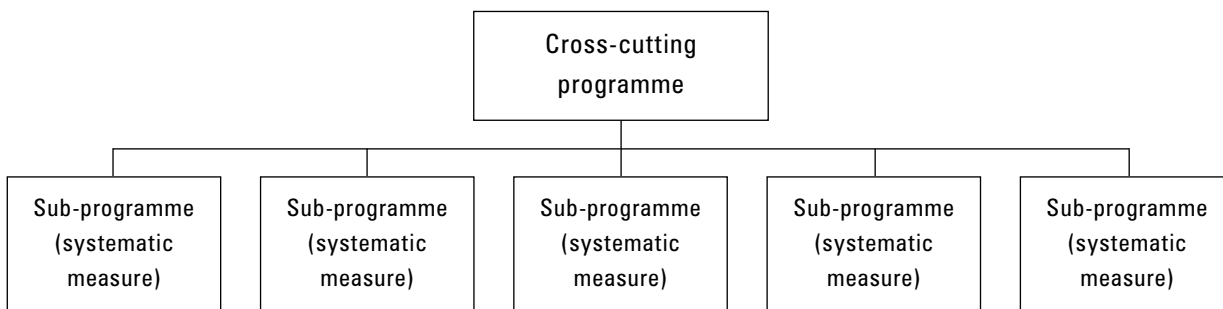
## PROPOSAL OF THE NATIONAL RESEARCH PROGRAMME PRIORITIES

The proposal of priorities of the National Research Programme is based on the work of panels (proposals of key research directions, systematic measures) which was followed by the activity of the working group (thematic sub-programmes, final selection of key research directions, systematic measures).

**Thematic programmes**, defined by the National Research and Development Policy of the CR, are divided into thematic sub-programmes. Sub-programmes include the final selection of key research directions – research priorities.



**Cross-cutting programmes** defined by the National Research and Development Policy of the CR are also divided into sub-programmes (systematic measures). The aim of the proposed sub-programmes is to ensure the optimum functioning of thematic programmes and of the NRP as a whole.



The National Research Programme consists of 5 thematic programmes which are divided into 19 thematic sub-programmes which include 90 key research directions. The programme further includes 3 cross-cutting programmes which are divided into 19 cross-cutting sub-programmes (systematic measures).

The structure of thematic and cross-cutting programmes is illustrated by the following tables.



## THEMATIC PROGRAMMES

<b>Thematic programme</b>	<b>Thematic sub-programme</b>
<b>Quality of Life</b>	<ul style="list-style-type: none"><li>• Human Health</li><li>• Quality and Safe Nourishment of Population</li><li>• Landscape and Settlements of the Future</li><li>• Environment and Protection of Natural Resources</li></ul>
<b>Information Society</b>	<ul style="list-style-type: none"><li>• Intelligent Systems for Decision Making, Management and Diagnostics</li><li>• Knowledge and Information Management</li><li>• Communication Infrastructure and Technology</li><li>• Computer-based Modelling and Design of Systems and Processes</li></ul>
<b>Competitiveness at Sustainable Development</b>	<ul style="list-style-type: none"><li>• Production Processes and Systems</li><li>• Safe and Economic Transport</li><li>• Building and Constructions</li><li>• Advanced Materials</li><li>• Emerging Technologies</li><li>• Utilisation of Natural Resources</li></ul>
<b>Energy for economy and society</b>	<ul style="list-style-type: none"><li>• Safe and Effective Nuclear Power Engineering</li><li>• Power and Non-Power-Producing Utilisation of Coal and Carbonaceous Raw Materials</li><li>• Rational Use of Energy and Renewable Energy Sources</li></ul>
<b>Modern Society and Its Changes</b>	<ul style="list-style-type: none"><li>• Performance-oriented, Safe and European-Integrated Society</li><li>• Social Cohesion, Social Differentiation and National Identity</li></ul>

The sub-programmes further include 90 key research directions that are given for the individual thematic programmes in the following tables.



<b>QUALITY OF LIFE thematic programme</b>	
<b>Human Health sub-programme</b>	<ul style="list-style-type: none"> <li>• Molecular biological and genetic methods and devices in the prevention, diagnostics and treatment of the most dangerous diseases</li> <li>• Use of new technological and information approaches and instrumentation in prevention, diagnostics and treatment of the most dangerous diseases</li> <li>• Preparation and characterisation of pharmacologically active substances based on new principles of action</li> <li>• Mechanisms of action and fate of medicaments in the organism</li> <li>• Health and its determinants including environmental factors</li> </ul>
<b>Quality and Safe Nourishment of Population sub-programme</b>	<ul style="list-style-type: none"> <li>• Diagnostics, therapy and prevention of diseases of livestock, alimentary infections and zoonoses</li> <li>• Development of methods for the appraisal of agricultural raw materials and food for ensuring their quality and safety</li> <li>• Genetically modified organisms, their utilisation and risk assessment</li> <li>• Plant health</li> <li>• Phytopharmaceuticals and food supplements in the prevention and health protection against chronic diseases</li> </ul>
<b>Landscape and Settlement of the Future sub-programme</b>	<ul style="list-style-type: none"> <li>• Man and landscape</li> <li>• Planning of the infrastructure of large cities and underground urbanism</li> <li>• Design of buildings with intelligent behaviour</li> </ul>
<b>Environment and Protection of Natural Resources sub-programme</b>	<ul style="list-style-type: none"> <li>• The interaction between man and environment</li> <li>• Reduction of the anthropogenic pressure on the environment</li> <li>• Waste generation and processing</li> <li>• Material flows and protection of natural resources</li> <li>• Instruments, methods and indicators for monitoring and protection of the environment</li> </ul>





<b>INFORMATION SOCIETY thematic programme</b>	
<b>Intelligent Systems for Decision Making, Management and Diagnostics sub-programme</b>	<ul style="list-style-type: none"><li>• Systems for automatic control and data acquisition</li><li>• Artificial intelligence and its applications</li><li>• Development of sensors, actuators and means for interactive man-machine communication</li><li>• Development of transport telematics and of intelligent transport systems</li></ul>
<b>Knowledge and Information Management sub-programme</b>	<ul style="list-style-type: none"><li>• Design, implementation and applications of large distributed computing, database and information systems</li><li>• Medical information and knowledge-based systems including personal systems</li><li>• Electronic documentation in health care systems, social security and public administration</li></ul>
<b>Communication Infrastructure and Technology sub-programme</b>	<ul style="list-style-type: none"><li>• Multifunctional communication networks including safety and protection of data</li><li>• Digital television and radio, providing interactive information services by exploring digital terrestrial television</li><li>• Devices and equipment working on the principles of quantum, statistical and wave optics, including devices and equipment for optical communications</li></ul>
<b>Computer-based Modelling and Design of Systems and Processes sub-programme</b>	<ul style="list-style-type: none"><li>• Devices for mathematical and computer-based modelling, simulation, and design of systems and visualisation</li><li>• Complex integrated circuits and systems, modelling, description and design including complex systems on one chip</li><li>• Software engineering</li></ul>



<b>COMPETITIVENESS AT SUSTAINABLE DEVELOPMENT thematic programme</b>	
<b>Production Processes and Systems sub-programme</b>	<ul style="list-style-type: none"> <li>• Technologies for protection and improvement of the environment</li> <li>• Textile materials and their technologies</li> <li>• Advanced steels and related technologies</li> <li>• New principles of elements, machine mechanisms and equipment of higher use value</li> <li>• New generation machines and equipment using modern top components</li> <li>• Catalytic processes</li> <li>• Organic syntheses for more sophisticated products</li> <li>• Reactor engineering, transport phenomena, multifunctional bioreactors</li> <li>• Progressive technologies for machining/tooling, cutting, joining and chipless material processing</li> <li>• Inorganic glasses and their technologies</li> <li>• Experimental research of machines and their components, devices and operational diagnostics</li> </ul>
<b>Safe and Economic Transport sub-programme</b>	<ul style="list-style-type: none"> <li>• Improvement of public transport and development of integrated passenger transport systems</li> <li>• Improvement of the technical conditions, modernisation of transport infrastructure and means of transport</li> <li>• New techniques and instruments for investment modelling of transport networks development</li> <li>• Sustainable transport systems and technologies</li> <li>• Ground communications of a new generation</li> </ul>
<b>Buildings and Constructions sub-programme</b>	<ul style="list-style-type: none"> <li>• Research and development of new technologies for supporting structures and their foundation</li> <li>• Development of methods for the optimization of materials and constructions and for the enhancement of reliability and durability of structures</li> <li>• Improvement of instruments for the optimization of economic characteristics of designing and building</li> </ul>
<b>Advanced Materials sub-programme</b>	<ul style="list-style-type: none"> <li>• Materials of a high strength-density ratio</li> <li>• Materials for high temperatures and stresses</li> <li>• Technical polymers and their composites</li> <li>• Advanced ceramic materials</li> <li>• Materials for biomedical applications</li> <li>• Advanced materials for buildings and constructions</li> <li>• Electronic and photonic materials and structures</li> </ul>
<b>Emerging Technologies sub-programme</b>	<ul style="list-style-type: none"> <li>• Nanotechnologies and nanomaterials</li> <li>• Intelligent materials and structures</li> <li>• Modern biotechnology</li> </ul>



<b>COMPETITIVENESS AT SUSTAINABLE DEVELOPMENT thematic programme</b>	
<b>Utilisation of Natural Resources sub-programme</b>	<ul style="list-style-type: none"><li>• Boosting competitiveness through development of higher consumer quality food</li><li>• Development of technologies for non-alimentary use of agricultural raw materials using production potential of agricultural crop</li><li>• Improving biological potential of production mechanisms</li><li>• Competitive production systems for sustainable and multifunctional agriculture</li><li>• Enhanced utilisation of renewable agricultural, petrochemical and tar-products for obtaining chemical products of higher value</li><li>• Development of technologies for water treatment and purification and rationalisation of water management in the country</li><li>• Sustainable forest management, producing and non-wood-producing roles of forestry</li><li>• Enhanced use of non-ore raw materials for materials of a wide application spectrum</li></ul>

<b>ENERGY FOR ECONOMY AND SOCIETY thematic programme</b>	
<b>Safe and Effective Nuclear Power Engineering sub-programme</b>	<ul style="list-style-type: none"><li>• Securing nuclear safety and reliability during the whole operating time of a nuclear power plant</li><li>• Increased effectiveness of the operation of the existing nuclear power plants</li><li>• Treatment of radioactive wastes and irradiated nuclear fuel and management of the end of the fuel cycle in a nuclear power plant</li></ul>
<b>Power- and Non-Power-Producing Utilisation of Coal and Carbonaceous Raw Materials sub-programme</b>	<ul style="list-style-type: none"><li>• Processing of coal in clean technologies</li><li>• Use of methane bound in coal deposits</li><li>• Providing for complex exploitation of coal substance</li><li>• Power engineering using fossil fuels</li><li>• Effective expansion of a combined production of power and heat and reliability of power-producing systems</li></ul>
<b>Rational Use of Energy and Renewable Energy Sources sub-programme</b>	<ul style="list-style-type: none"><li>• Instruments for enhancing the efficiency of energy use</li><li>• Utilisation of renewable power resources</li><li>• Advanced technologies for power production, renewable power sources and energy conservation</li><li>• Development of less power demanding technologies in the agricultural and food production</li></ul>



<b>MODERN SOCIETY AND ITS CHANGES thematic programme</b>	
<b>Performance-Oriented, Safe and European-Integrated Society sub-programme</b>	<ul style="list-style-type: none"> <li>• Economic performance and market relations – social, political and environmental context</li> <li>• Formation and stabilisation of the political and legal institutional framework</li> <li>• International integration and globalisation</li> <li>• Social, economic and safety aspects of health and disease</li> <li>• Economic and social context of a sustainable development</li> </ul>
<b>Social Cohesion, Social Differentiation and National Identity sub-programme</b>	<ul style="list-style-type: none"> <li>• Social and cultural cohesion in a differentiated society</li> <li>• Open society: social and cultural adaptability</li> <li>• Knowledge society and new forms of education</li> <li>• Socioeconomic, sociological and demographic conditions for the preservation and development of the countryside</li> <li>• Conditions and effects of the population reproduction and demographic ageing in the process of modernisation</li> </ul>



## CROSS-CUTTING PROGRAMMES

Cross-cutting programme	Cross-cutting sub-programme (systematic measure)
<b>Human Resources for R&amp;D</b>	<ul style="list-style-type: none"><li>• Seminar – formation of a permanent discussion platform on the issue of human resources for R&amp;D</li><li>• Public tender of research projects in the thematic fields:<ul style="list-style-type: none"><li>– The work of a scientist on a domestic labour market</li><li>– External and inverted brain drain</li><li>– Modernisation activities in the Czech R&amp;D in the 1990s and their influence on the formation of present human resources</li><li>– Influence of grant financing on the development of human resources in the Czech R&amp;D</li><li>– Demographic and social structure of the Czech R&amp;D</li></ul></li><li>• Supporting programme of the development of human resources for R&amp;D:<ul style="list-style-type: none"><li>– children and youth</li><li>– young scientists up to 40 years of age</li><li>– top managing scientists</li></ul></li></ul>
<b>Integrated R&amp;D</b>	<ul style="list-style-type: none"><li>• Adoption of the principles of the innovation policy of the CR</li><li>• Creation of an appropriate legal framework for the development of cooperation between research and industry</li><li>• Support of the integration of R&amp;D</li><li>• Analysis of the existing activities of research centres</li><li>• Creation of a legal framework for intellectual property rights</li><li>• Support of the partnership of public and private sectors</li><li>• Support of the participation of small companies in innovation processes</li><li>• Support of the establishment of funds for setting up technologically oriented enterprises</li><li>• Support of the development of human resources</li><li>• Improvement of research evaluation</li><li>• Provision of the coordination of the above-mentioned activities</li></ul>
<b>Regional and International Cooperation in R&amp;D</b>	<ul style="list-style-type: none"><li>• Support of the cooperation between strong and weak regions in R&amp;D</li><li>• Support of the transfer of R&amp;D and innovation results to weak regions</li><li>• Boosting R&amp;D capacities in weak regions</li><li>• Support of the participation of R&amp;D entities in international projects according to the criterion of added value</li><li>• Support of the R&amp;D involvement in the European Research Area</li></ul>



## FURTHER DEVELOPMENT AND IMPLEMENTATION OF THE RESULTS

The results of the project were used for preparation of the final version of the proposal of the National Research Programme for the session of the Government of the CR in May 2002. Following the adoption by the Government, preparatory work aiming at gradual implementation of the NRP into the existing system of support of research and development in the Czech Republic from January 2003 will be carried out in the second half of 2002.

## CONCLUSION AND RECOMMENDATIONS

The main results of the project are the proposal of priorities of the oriented research in the Czech Republic, recommendations related to the supporting systematic measures and the proposal for the implementation of the programme, together with the methodology of its operative management. The proposal was prepared under cooperation of several hundreds of top Czech experts from the research and consumer sphere. In preparing the project foreign experience and methodologies were used which were appropriately modified and combined according to the current situation in research and development and according to the economic and social needs of the Czech Republic.

The formation of a wide discussion forum of leading scientists, researchers, industrial managers, entrepreneurs and representatives of the state administration and other organisations is also an important outcome of the project. It is desirable to utilise the potential of this expert group as a qualified forum of experts in an appropriate manner even after the project has been completed. Updating the selection of research priorities is a continuous process that must react to the developing economic and social needs of the country.

Another recommendation of Czech experts, supported also by the international expert panel, consists in maintaining the continuation of technology foresight activities in the Czech Republic. The first recommended step is to make a detailed evaluation of the project, its assets and drawbacks, together with a proposal of the follow-up activities. At the same time it is necessary to create relevant institutional structures able to carry out complex strategic studies focused on research and technological priorities and their relations to and influence on the economic and social situation in the Czech Republic. It is also necessary to follow similar projects abroad and to pay special attention to the activities of the European Commission that included technology foresight in the priorities of the next framework programme of international cooperation in R&D.



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