UNDP
Kazakhstan

NATIONAL HUMAN DEVELOPMENT REPORT

New technologies for human development in Kazakhstan

EXECUTIVE SUMMARY

The purpose of economy is human development aiming to ensure a decent life

Present-day development trends create the need for a new approach to defining the purpose of development and the economy. The traditional definition states the main purpose of an economy is to meet growing human needs with finite resources. Today, recognizing the important role of human development, this definition should be changed to say: "The purpose of an economy is human development aiming to ensure a decent life". Human development is understood to be the continuous expansion of human opportunities to enjoy or have a choice of political, economic, social, spiritual and cultural participation. A decent life implies broad-based access to high-quality education, healthcare, social schemes, healthy food, extensive participation in society and other benefits contributing to human development both culturally and financially.

Having committed to the UN-declared concept of development from the perspective of opportunities, Kazakhstan has made continued efforts to promote its human development level. The most valuable resource in the long-term development strategy "Kazakhstan-2030", a key national development document, is people. The 2030 strategy also identifies national development priorities that help improve all spheres of life for each and every Kazakhstani.

Kazakhstan's strong economic development has allowed it to put new items on the development agenda to facilitate the implementation of the Kazakhstan-2030 strategy. These new challenges are set forth in the President's Address to the People of Kazakhstan of 1 March 2006 "Strategy for Kazakhstan to become one of the world's 50 most competitive countries". The Strategy emphasizes the need for innovative development, which will be the basis for Kazakhstan's breakthrough in the context of globalization.

New technologies can become a tool for enlarging people's choices

The National Human Development Report "New Technologies for Human Development in Kazakhstan" recognizes the importance of new technologies, which are considered through a human development prism, and assigns primary focus to the government's work in the interests of its people. The Report calls for reflection on the need for an innovative stage of national development, highlighting some of the pitfalls that can hinder human development. It acknowledges the role of technologies in the development of human capital and discusses Kazakhstan's human development level, as well as progress towards the Millennium Development Goals, use of technologies for the development of human potential and the current status of technological development in Kazakhstan.

Technologies as a tool for social and human development

The first chapter looks at human development as an end, to which human development factors such as economic growth, education, healthcare and good environment are the means: new technologies are regarded as a tool for the development of human potential.

Thus, innovations improve productivity, profits and people's income and ensure access to better quality goods and services. New technologies have a positive effect on human and social health by reducing deaths and increasing births and life expectancy. The introduction of new technologies in education is vital to the competitiveness of national human capital. Modern technologies promote effective resource use and can contribute to public participation in society.

However, the authors also mention the potentially mixed human development implications of new technologies. There are economic risks that can significantly affect the overall effect of new technologies on economic development, while environmental and manmade risks preclude unconditionally positive impacts of new technologies on human development. At the same time, access to new technologies may contribute to growing inequality in relation to income, place of residence, age, sex, etc.

Therefore, multi-dimensional effects of new technologies on human development suggest the need for a selective approach to the development, choice and use of technologies. The chapter recommends the development of criteria for choosing new technologies to promote increased income levels, improved literacy and life expectancy and other human development components, and minimize risks.

Human development as Kazakhstan's strategic priority

As with the previous report, the second chapter reviews the status of human development in Kazakhstan through an overview of the Kazakhstan-2030 Strategy and identification of new challenges to be addressed to ensure sustainable human development. The authors believe that the principal national concept should now be the transition to sustainable development, which is an objective requirement that can realize the long-held dreams of the Kazakh people in terms of national welfare, nature, culture and each Kazakhstani's health and well-being.

To ensure sustainable human development at the current stage, Kazakhstan needs to:

- improve life expectancy. Not only should Kazakhstan work to increase births, but also take care of those already born. In particular, the excessively large disparity between female and male life expectancies should be addressed;
- address the health targets of the Millennium Declaration relating to reduced child and maternal mortality, halting and reversing the spread of HIV/AIDS and other diseases;
- ensure that extracting companies and the Government join the Extractive Industries Transparency Initiative (EITI);
- achieve a number of targets related to professional government and decentralization and continue anti-corruption efforts;
- improve the quality of education towards Soviet period standards, based on the needs of both the economy and human development;
- develop fundamental and applied sciences.

Specifically, the chapter attempts to show the relationship between competitiveness and the development of national human capital. The chapter's message is that, although an important step towards the long-term development strategy Kazakhstan-2030, Kazakhstan's aim of becoming one of the world's 50 most competitive countries should not be considered the ultimate goal of the country's development. It serves a higher and more complex goal of ensuring broad-based opportunities for all people of Kazakhstan in all spheres of life or, in other words, human development.

Current and future status of new technologies in Kazakhstan

Developing national capacity in science and technology is instrumental to achieving a high level of economic productivity through the use of new technologies to ensure the human development and economic and social well-being of the nation.

The review of the current status of and trends in the development of science and technology focuses on the key components of science and technology, including strengths and weaknesses of the scientific and research system.

The following challenges are identified:

In the area of human resources: the ageing of highly qualified cadres (scientists and engineers); deteriorating prestige of the scientific profession; limited inflow of young talent in science and technology and low qualifications of the cadre with technical education.

In the area of funding of research and development (R&D): limited commitment of business and private sectors to participate in R&D programs and projects and lack of correlation between R&D outcomes and market needs and context.

Multi-dimensional effects of new technologies on human development suggest the need for a selective approach to the development, choice and use of technologies

In order to promote innovative business development recommendations are provided to ensure links between science and production. To this end, attention should be paid to the innovative activity of large and small enterprises, such as the rate of use of innovation and the responsiveness of businesses to innovation introduced by competitors, which can contribute to competitiveness of such businesses through reduced production costs.

In addition, an important factor in the introduction of new technologies is the infrastructure facilitating human development: ensuring social receptiveness towards the introduction of technologies; equal access of a wide community and all groups of the population to social and technological resources; a high rate and flexibility of production; extensive use in all spheres of life.

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Also, of special importance for technological development is review of international practices and comparative analysis of the status of science and technology in Kazakhstan and other countries. In international practice there is a wide range of economic instruments of scientific, technological and innovation policies that can be used to govern the processes of innovation at the micro and macro levels.

Kazakhstan should create an environment conducive to technological development. Based on improved science and technology and human, financial, administrative and legal resources, Kazakhstan should address a range of social and economic issues to expedite innovative activity and production of science-intensive and high-tech products and services aiming to directly enhance the welfare of Kazakhstan's people and meet their needs.

Promoting an enabling environment for new technologies in Kazakhstan

The fourth chapter describes the environment required for the development of new technologies. It looks at innovation as a continuous non-linear process, which embraces not only research and development but a wide range of actions such as training, design, financial marketing, etc. Innovative national development is only possible through successful implementation of a range of actions.

Using a systemic approach to the environment for new technologies in Kazakhstan, the chapter studies each component or sub-system of the national innovation system, such as science and research, innovative business development, technological infrastructure and financial institutions. The authors draw attention to the services that ensure linkages in the innovation process and define the role and functions of the players in the creation of new technologies. The defined role of the players in the innovation process allows identification of gaps in the innovation system and additional services to be provided to innovative enterprises that can speed up the development of innovation systems and new technologies in Kazakhstan.

Furthermore, the fourth chapter analyzes the existing legal framework as the basis for the development of new technologies in Kazakhstan. The authors conclude that Kazakhstan's laws pertaining to different aspects of innovative activity, including forms of small business organization, lacks integrity and should be improved. Not only should new laws be adopted but some incomplete documents should be completed, existing instruments amended and conflicting provisions removed.

Also, there are some legislative gaps that indirectly affect technological development and these should be addressed, particularly those related to intellectual property. There is a direct relationship between the legal protection of intellectual property and new products.

All of the above factors and mechanisms are necessary to lay the foundation for the development of innovative processes that will enable the creation and use of new technologies for the benefit of socio-economic development in Kazakhstan.

Kazakhstan's technological capacity

This chapter does not attempt to review all technologies. The authors focus only on the following four technologies: traditional technologies for natural resource extraction and processing; energy-saving technologies and alternative energy sources; biotechnologies and social technologies.

The authors believe that the effective development of science and technology is based primarily on justified priorities and the subsequent concentration of scientific capacity and financial and material resources on achieving such priorities. To this end, the Government's support to research should concentrate efforts on facilitating the maintenance and development of 'breakthrough' innovative projects.

Let us look at the conclusions and recommendations for each group of technologies in more detail:

Resource-extracting and processing technologies.

Kazakhstan is a country with rich mineral resources[1]. At present, however, mining and the use of available technologies are not up to the mark, since most of the technologies for non-ferrous and less-common metal production fail to comply with modern environmental standards, economy and efficiency and the complex use of mineral materials.

In this regard, in order to introduce new technologies for the effective management of the mining and smelting sector, technologies should be used to reduce damaging emissions, make processing and use of raw materials more comprehensive and complete, produce pure metals and alloys, products and materials and set up flexible, environmentally friendly automated productions, etc.

Petrochemical and chemical industries.

Although rich in reserves, the domestic petrochemical industry faces a number of challenges, such as the export of processed products, although the majority of oil products are imported; incomplete processing of oil and gas resulting in huge waste and lower quality; lack of hydrogen production required for hydrorefining, etc.

To address these, existing processes should be enhanced and new production complexes capable of complete processing and refining should be built, while a mechanism to engage all companies (private, government-owned and mixed) in the process should be developed, so as to interest them in increasing oil recovery and improved environmental management.

Energy-saving technologies and alternative energy sources.

In order to ensure the required energy supply, energy resources and fossil fuel should be used and managed effectively. The development, introduction and use of new technologies should enable more effective energy consumption in all economic sectors, while new, renewable energy sources and effective environmental management will enhance sustainable development. More effective use of fuel and energy should translate into a means of environmental management and pollution control.

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On a wider scale, to put in place energy saving measures and ensure an effective national energy-saving policy, a plan of action for organizational, institutional, legal, financial, scientific, technical and educational components of energy-saving policy should be developed. The plan should be based on awareness of available energy-saving techniques in each economic sector, and selection of the most suitable and justified criteria for different categories of energy users and prioritization.

Biotechnologies.

Biotechnologies have potential benefits for human life. Biotechnological development can be used in different sectors, such as in agriculture to increase productivity and develop and use new highly productive varieties of crops, breeding of valuable genotypes of cattle, etc; in healthcare to produce important new medications, biotechnological blood specimens, genetically engineered drugs, immunological medicines, biosensors and biochips, etc.; in the extracting industry to produce oil and purify environmental objects from oil pollutants; in power engineering to add to bioethanol gasoline and as fuel (biodiesel) for diesel engines.

However, biotechnology research should first consider ethical aspects, with careful research and experiments to identify potential risks and the need for well-equipped laboratories, etc.

[1] "Kazakhstan's industries", 3 (30) 2005.

Technological development should, primarily, impact on potential productivity and effective management of resources and build technological and social capacities in Kazakhstan

Social technologies.

This section studies social technologies, their capacities and scope of use. Today social technologies offer the best solutions to a number of issues and challenges faced by each and every person both in production and life. However, at this stage, although used in Kazakhstan, the implications of social technologies have not been reviewed or researched. In this regard, the authors recommend a comprehensive analysis of the capacities and implications of social technologies and potential risks.

Technological development should, primarily, impact on potential productivity and effective management of resources and build technological and social capacities in Kazakhstan.

New technologies for the benefit of Kazakhstan's people

The proposed comprehensive set of activities and recommendations should be extensively supported by all players in the technological process, namely government, businesses, the scientific community and the public

Ideally, development of new technologies and an innovative process should aim to ensure sustainable economic development and meet national needs, improve quality of life through new jobs, enhance the educational level, address production, environmental and social issues, provide production with modern equipment, improve the working environment for support personnel, minimize environmental impacts, etc.

The underdevelopment of present-day science and technology infrastructure, lack of financial support from government, a deficient legal framework, and lack of public receptiveness to the introduction and use of new technologies are the main factors hindering the process of innovation. To remove these barriers, the authors suggest a unified approach, under which the legal framework will be improved, national science and technology policy developed, infrastructure improved and public readiness ensured.

Such a comprehensive set of activities and recommendations should be extensively supported by all players in the technological process, namely government, businesses, the scientific community and the public, all of whom should realize the shared goal of achieving sustainable social and economic development and ensuring a high quality of life and empowerment of human capital.

The National Human Development Report 2006 throws light on new, previously overlooked challenges related to technological development in Kazakhstan. It is a review of the development and introduction of new technology through the prism of human development, allowing analysis and drawing attention to current challenges, and calling for a selective and informed approach to the use of technologies.

Technological development will only improve the welfare of Kazakhstani society if it is combined with a detailed review of all current and future developments and activities, based on recommendations and conclusions resulting from such a review. Effective implementation of this will enable the creation of a competitive system of innovation that will guarantee both successful human development and a knowledge-based economy in Kazakhstan.

CHAPTER 1. TECHNOLOGIES AS A SOCIAL AND HUMAN DEVELOPMENT TOOL

1.1. Technologies in human life

Balanced and sustainable development implies an environment and prerequisites for human development, which is measured not only by income levels but also factors such as the opportunity to live a long and healthy life, acquire knowledge, access resources required for a decent life and participate in society. In a wider sense, the term "human development" embraces all aspects of personal development, ranging from health to economic and political liberties.

Presently, human development is viewed as a process of expanding both human opportunities and capabilities. Therefore, this concept has itself been developing as new elements of human development emerge, indicating increasing public loyalty.

Society has come to understand that human development is an end to which economic growth, education, medicine and a good environment are the means. New technologies, in turn, are a recognized tool for economic, educational, healthcare, environmental and democratic development, as well as overall human development.

In this regard, there is now a need for a comprehensive evaluation of new technologies from the perspective of their implications for human capacity development. In addition, it is important to identify an environment where new technologies can become an effective tool for expanding human choices. However, before the role of new technologies for social and economic development is explored, the notion of new technologies should first be clearly defined.

New technologies or **innovations** are the result of innovative activity presented on the market as a new or improved product (product innovation) or a new or improved technological process used in practice (process innovation)[2] . The classic definition was put forward by J. Schumpeter: "Innovation is commercialization of all new combinations based on new materials and components, new technological processes, new markets or new organizational forms".

There is a variety of other definitions. The authors, however, believe that what defines all types of new technologies is how well they can improve productivity and income, reduce poverty, promote employment and develop civil society. The value of new technologies lies solely in the mechanisms and intensity of human implications and resulting effects on social structure and social relations as a whole[3].

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Let us look at the types of new technologies. *By nature of application* there can be product innovation oriented towards production and use of new or improved production and technological innovation aimed at creation and use of new or improved *technologies.*

In his book "Innovator's Dilemma" Clayton Christensen says that the majority of new technologies are *"compatible",* i.e. they can improve the quality of existing products within the scope of characteristics important to the main users. Compatible technologies can be fundamental and complex without affecting the core of a product. In contrast to compatible technologies, *"disruptive"* technologies bring only new ideas to the market. Disruptive innovation is, for example, transistors versus electronic tubes or personal computers versus typewriters. Such innovation can potentially be a product, which is smaller, simpler, cheaper and more user-friendly.

Depending on the *field of development and introduction* there are medical, information and communication technologies, biotechnologies, nuclear technologies, nanotechnologies, social and educational technologies, etc.

Social technologies cover several fields of human activity and can be used in medicine, education, governance, etc. Social technologies are understood to be technologies used in social relations, i.e. man-to-man rather than man-to-machine or man-to-nature relations.

Today social technologies offer optimum solutions to a number of issues any person may face in their productive and personal lives, at an individual level, in interpersonal communication, in governance, management and business[4]. For example, in medicine, social technologies can improve the efficiency of doctor-patient communication; in education administration-student/faculty

[2] *http://www.tppsk.ru*
[3] *M. Delyagin. Globalization– 6, Analytical club of the Information Analysis and Management School. Section "Social crisis, social changes, social revolutions". Moscow - 2005.*
[4] *www.soctech.narod.ru*

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and faculty-student communication, while in public administration such technologies promote public participation in social life and enhance government-public communication.

In particular, social management technologies are used in almost all fields and affect communication between the objects and agents of management. New management technologies can make work more effective through optimized management schemes and techniques.

Another type of social technology, known as civil technologies, engage volunteers and voluntary donations in civic activities. Most civil technologies are borrowed and have prototypes in political, administrative, legal and business practices, the only difference being that agents, owners or operators of such technologies are civil actors (non-profit organisations, public initiative groups or public leaders) and the purpose is lobbying, or advocacy of public interests.

Another technology classification criterion is relative effectiveness, depending on which technologies may be considered new or old. As noted, new technologies are more effective and efficient, can better meet customer needs and have more impact on human development than old technologies. Old technologies are less efficient and science intensive. New technologies are gradually replacing old and inefficient ones. This results in growing productivity and more effective use of natural resources, reducing the energy intensiveness of products and environmental pollution, while exhaustible natural resources are replaced by others that facilitate comprehensive human development. The communications sector is an example of scientific and technological progress replacing old technologies. Obviously, telegrams have become less popular, since most people prefer to use e-mail - a new technology - for information exchange.

ITC enable better participation in civic activities

Indisputably, old technologies are inevitably replaced by new ones as new communications and services develop. Another example is that the old educational system was replaced by a new one known as credit technology. Two conflicting processes – globalization and competition – make it vital for post-Soviet states to replace traditional educational technologies with a new one, which is traditional for European countries. This shows that traditional technologies do not necessarily mean old technologies.

This report looks at both the positive and negative effects of new technologies on the development of human potential. Examples of globally-recognized new technologies that are fast developing and important for human development include information and communication technologies, biotechnologies and nano-technologies.

Information and communication technologies (ICT) are one of the fast developing technologies. ICTs are an increasingly important development factor and have a significant impact on the political, economic and social life of many countries. Although many people associate such technologies primarily with mobile and more advanced technologies, a more accurate definition of ICTs embraces all technologies which process information and enable communication. The scale of social development implications of ICTs becomes clearer when the definition of ICTs includes both old and new technologies, ranging from newspapers, radio and television to video cameras, computers and cell phones.

Information and communication technologies enable better participation in civic activities. ICTs are increasingly used to meet the basic needs of young people around the world, such as access to education, employment opportunities and public participation in social life.

The links between new mass media and youth ensure young people’s activity at a general level and affect its different types. New technologies help inform the public directly and facilitate immediate communication. However, in many countries the Internet as a means of mass media is the least controllable medium and can be a powerful tool for radical propaganda groups.

If available, ICTs enable access to better quality education. Many schools and vocational training colleges use ICTs for part-time students and to train teachers in new teaching methods. ICTs can help update and distribute training courses more effectively. ICTs can be utilized in education, depending on how well they are used, although there are standard methods to identify cost-effective and country-specific solutions enabling better access to education through ICTs. Technologies change classroom methods through use of multi-media manuals, Internet-based material and information for essays, etc., which makes the learning process more interactive.

ICTs can be particularly effective in reaching rural communities with no access to large libraries and other educational resources. However, it is rural areas that have more limited access to new information technologies. Therefore, the rural education implications of new technologies are still unclear. Currently, even at the global level there are significant disparities in access to and use of many ICTs.

To reduce the 'digital divide' Kazakhstan has adopted the "Program for Digital Divide Reduction in the Republic of Kazakhstan for 2007-2009" aiming to facilitate effective use of the Internet on a routine basis by at least 20% of the population and promote the social and economic importance of information resources in Kazakhstan[5].

Nanotechnologies are another promising type of technology that can be potentially huge in such varied areas as pharmacy, water disinfection, information and communication technologies, production of durable and light materials, etc.

Nanotechnologies are used to make super microscopic elements out of the smallest parts of tissue. The term stems from "nanometer" (a millionth of a meter). At the global level, research centers mainly use nanotechnologies in three areas: production of electronic circuits, including three-dimensional circuits, with active elements, the size of an average molecule; development and production of nanomachines, i.e. nanosize mechanisms and robots; direct manipulation of atoms and molecules and making things from them.

Nanotechnologies can lead to a new global technological revolution and change the human environment. Scientists say that the most recent nanotechnological achievements can be somewhat like solutions to cancer. A new development by Sivida called BrachySil can deliver anti-cancer medicine to the target, i.e. cancer cells, whereas radio and chemotherapy can have damaging side effects. Theoretically, nanotechnologies can make people live eternally, because nanomedicine can endlessly regenerate dead cells. Nanotechnologies may cause an agricultural revolution and stabilize the environmental situation. Nanotechnologies can be used for absolutely no-waste production.

Over the last five or six years dozens of countries have treated national nanotechnology programmes as supreme national priorities. Recognizing this, economically developed countries such as the US, the EU, Japan and China pay special attention to nanotechnological research and have special nanotechnology development programmes[6].

Biotechnologies have developed into the most important technology for human development resulting from their use in sectors vital for human development.

Biotechnological trends in science and production emerged as a result of the rapid progress of different elements of physical-chemical biology. Biotechnology has been establishing itself over the last twenty years and is now at a peak of development.

Now the increasing use of biotechnologies in different fields of medicine, pharmacology, veterinary science and agriculture is becoming an integral part of scientific and technological progress.

An important factor distinguishing biotechnology from other fields of science and production is that it initially focuses on present-day concerns such as food production, primarily proteins, and the maintenance of natural energy balance through a shift from non-renewable to renewable resources and environmental protection.

However, the lack of a legal framework for biotechnologies and lack of basic bioethics awareness can have an adverse effect, which is human anti-development. The growing threat of bio-terror and the developing production of dangerous chemical and biological material make effective use of biotechnology research and development of utmost importance.

Clearly, technologies significantly affect lifestyles, quality of life and human development. Recognizing this, many countries have come to pursue scientific and technological development policies. At the same time, are their national contexts conducive to technological development? How effective can such a policy be and what are the success factors? Answers to these questions vary from country to country depending on their socio-economic, cultural and historical development.

One negative implication of new technologies is the unequal access that developed and developing countries and privileged and disadvantaged groups of the population have to them. Local customs and traditions can enable or hinder access to new technologies, and these should be taken into account when developing a national policy for technological development.

Another issue is the adaptation of new technologies. Something may be unique but if people cannot use it, it can become useless. If unused, new technologies may be useless. Therefore, adaptation of new technologies in a society is important and should be considered in scientific and technological policy.

The effectiveness of new technologies is determined by factors such as culture, mentality, history, government support, staff capacity, etc. This points to the need for a selective approach to the introduction

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[5] RK Governmental Decree #995 "On approval of Programme for Digital Divide Reduction in the Republic of Kazakhstan for 2007-2009" of 13 October 2006

[6] S.Capitsa. Review of the Current Status of the Russian Science. Izvestia. May, 2004

Отсутствие правовых основ использования биотехнологий, незнание основ биоэтики может привести к обратному эффекту — эффекту человеческого антиразвития

and transfer of technologies based on both issues around social adaptation and the different effects of technologies on human development.

1.2. Potential human development implications of new technologies

The last decades of the 20th century saw both rapid development of technological innovation and rapid introduction of new technologies in society. Such innovations can be seen in any city of the industrial world, but particularly in newly industrial countries. However, the extent to which they will impact the future is difficult to say, while the implications of technologies in developing countries, accounting for two thirds of the world's population, are most difficult to predict. If a wave of technological innovation results in the second industrial revolution forecast by some scientists, developing countries should either be able to be in it or risk lagging behind.

Technologies are a factor of national economic growth

The first UNDP Human Development Report released in 1990 said that more choices determine human development. Choice is understood to be a certain level of access to higher income, better quality education and healthcare, a good environment, as well as freedom of action and speech[7]. New technologies are supposed to provide such choices and promote social and economic development on the whole and human development in particular. Let us look at how new technologies affect the four main aspects of human development: income, health, education and public participation.

Box 1.2.1.

Technologies for growth competitiveness

The 2002 Global Economic Forum suggested a Growth Competitiveness Index to measure national capacity for economic growth. The index was developed and put forward by economic scientists Jeffrey Sachs and John McArthur as part of the Global Competitiveness Report for 2001-2002.

The pillars of the Growth Competitiveness Index are the macroeconomic environment, public institutions and technologies. For the core innovators, the weightings are as follows:

Growth Competitiveness Index for core innovators = 1/2 technology index + 1/4 public institutions index + 1/4 macroeconomic environment index (1)

Core innovators are countries with more than 15 US utility patents registered per million population; non-core innovators are all other countries, for which the Growth Competitiveness Index is based on a different formula:

Growth Competitiveness Index for non-core innovators = 1/3 technology index + 1/3 public institutions index +1/3 macroeconomic environment index (2)

Source: The Growth Competitiveness Index: Analyzing Key Underpinnings of Sustained Economic Growth. Jennifer Blanke, Fiona Paua, Xavier Sala-i-Martin. Report to the World Economic Forum

New technologies and economic growth

National revenue is one of the most important factors in determining human welfare. However, economists still focus more on factors of national economic development. The most prominent economists of the last two centuries tried to explain what is needed to promote national economic development. As the science developed, the following factors were considered: specialization and division of labor, natural resources, investment in physical capital, international assistance, education, technological progress, as well as economic openness, macroeconomic stability, public administration, legal framework, lack of corruption, market orientation and many other factors. A review of the impact of such factors shows that economic growth is a complex process for which there is no magic recipe. A combination of factors is required for a country to succeed.

According to the Global Competitiveness Report, technologies are a factor in national economic growth, while one of the main lessons of neoclassical growth theory is that long-term economic development is impossible without technological progress[8].

So, how does technology affect national economic growth and efficiency? For example, information and communication technologies help people to collect, process, store, retrieve and pass on information. Technologies can help improve the situation for companies in developing and developed countries, and may enable developing countries to be more competitive in the global economy. Also, effective management technologies can make produce more competitive and expand market presence.

In production, new technologies increase productivity, allowing companies to increase remuneration without raising prices, thus facilitating real non-inflationary increases in income. For example, a recent study undertaken by the US Ministry of Trade shows that investment in new technologies by US companies over recent years has had an extensive and long-

[7] *Human Development Report 1990. UNDP.*
[8] *Blanke J., Paua F., Sala-I-Martin X. The Growth Competitiveness Index: Analyzing Key Underpinnings of Sustained Economic Growth // World Economic Forum. – 2004.*

term effect on national production. This suggests that effective use of technologies can help organizations to use available resources more effectively and be more competitive.

However, technologies can have negative effects on economic development. One such effect is loss of economic autonomy. For a developing country specializing in production of a certain type of products, technological innovation of other countries can lead to loss of economic independence.

Another possible negative effect is dependence on supply of labor resources, fuel, information and equipment. A recent embargo on Haiti and the isolation of Cuba are examples of difficult situations resulting from a deficit of supply.

The excessive use of resources directly related to economic development leads to environmental problems such as pollution with growing waste. Ruthless use of natural resources is a tragedy for developing countries.

However, the relationship between new technologies and economic growth is not one-way: economic prosperity also determines the status of science and technologies, just as new technologies determine economic progress.

Box 1.2.2.

Economic risks of new technologies

The introduction of new technologies in the production and overall development of new technologies can also have economic implications.

It takes at least three years and continuing funding to research a new scientific product. If the owner fails to continue research, the invested capital will be wasted. Also, risks can be related to the outcomes of the research. Another risk is that science-intensive production is often highly competitive. All these factors can eventually lead to financial constraints or bankruptcy of the owner.

Developing countries, including Kazakhstan, are affected by other factors including restricted markets, limited supply of raw materials, lack of qualified personnel and under-developed infrastructure.

Technologies always involve risks, while the implications of such risks may vary. Some risks can be minor, i.e. can be averted with little cost and effort. Other risks are more difficult to compensate for but, in any case, allow acceptable profits to be made. Finally, risks can be so significant as to cause the collapse of an enterprise. For example, the risk of toxic waste resulted in the closure of some plants in the United States after the chemical disaster in Bhopal, India.

Source: United Nations Industrial Development Organization (UNIDO)

New technologies and health

Technologies play a significant role in healthcare and medicine. Developing countries are increasingly using new technologies in the provision of medical services, particularly to those living in remote areas with lack of medical specialists. Examples of the use of new technologies include long-distance patient/doctor consultations, diagnosis and even treatment; collection of data for research and diagnosis; on-line cooperation between physicians and medical researchers in different parts of the world; more timely and effective national and institutional responses to epidemics, as well as overall improvement in the quality of medical care. New technologies are also used to deliver health services in remote rural areas where more traditional medical services are lacking.

In addition, advanced technologies play an important role in responses to HIV/AIDS, tuberculosis, malaria and other diseases. New technologies open new horizons for physicians and patients and can shape new healthcare. At the same time, there are significant barriers to the use of new technologies. For example, a WTO-proposed monopoly of seven pharmaceutical companies in vital new medicines for AIDS[9] , malaria and tuberculosis, the research for which has only just begun, completely contradicts the concept of human development.

The special status of the health sector should be considered when looking at the health implications of technologies. This status is determined by the fact that many social development products have a unique impact on human and social health. These include economic products, the level and even distribution of which determines the status of the health sector. Economic products include clean water and air, a safe working environment, transport and communication networks that provide access to medical centers and health centers.

Another determinant of the status of the health sector is education. Effective education provides for staff capacity, not only to handle medical technologies but also protect and improve human health. Education contributes to growing numbers of scientists engaged in medical research, which help ensure a high level of healthcare. Therefore, healthcare, the economic situation, education and infrastructure are all indirectly linked.

However, healthcare is not a simple derivative of the development of other spheres in a society but can itself affect them

Loss of economic autonomy and dependence on external supplies can have negative effects on economic development

Advanced technologies can play an important role in responses to HIV/AIDS, tuberculosis, malaria and other diseases

[9] http://www.inopressa.ru

significantly. Various causes of poor health can limit human choices of occupation, place of residence, socialization and other elements integral to the quality of life. It is unacceptable for poor health to be the result of lack of knowledge, neglect or untimely access to existing methods of treatment and prevention.

Extensive and close links between healthcare and other aspects of human life suggest that not only technologies but also the economic situation, environment, education and national staff capacity can improve healthcare.

New technologies open doors to quality education and training. However limited access to ICT poses significant barriers to some groups of population

New technologies and education

Globalization has shaped a new concept of economy and economic development. The present notion of an economy implies "information economy" based on technological development that enables rapid high-quality information exchange between all spheres of life and all members of society. A new economy and globalization blur national boundaries of competitiveness and make national intellectual and educational capacity a key resource for economic growth and improved welfare. Therefore, technologies, science and innovation form a mechanism for the development of human resources and the building of intellectual and educational capacity.

New technologies open doors to higher education and training for students and general population. In particular, wide access to information technologies enables communication between learners and educators of different regions and countries. This increasingly impacts teaching methods and the role of educators and educator-learner communication and makes learners more independent. Also, educators have an opportunity to develop professionally and work in cooperation with international counterparts or attend on-line workshops using video conferencing. In addition, educators can experience the advantages of new information technologies by offering learners more complex assignments and encouraging their academic interest and activity. This helps to diversify academic programs versus more traditional forms of learning based on repetition and rote-learning.

However, it should be borne in mind that rural areas have limited access to information technologies due to underdeveloped infrastructure and expensive Internet services, which is a significant barrier to the use of new technologies and other accompanying benefits. By ensuring every school has access to new technologies, digital standards can be widely promoted and social inequality mitigated. Tools offered through modern information and communication technologies contribute to more interactive learning, which helps learners to be confident about their future and use their intellectual capacity for life-long learning.

Also, ICTs are an important tool to promote informal education, which means "any learning programs that can be taught outside the formal education system, either in a family or social context, in groups or individually, using mass media, long-distance or through informal communication"[10]. In other words, it means knowledge and skills learned through periodicals or the Internet.

New social technologies used in education seek to enhance educational levels through effective communication between such social groups as school administration, educators and learners. The context for the adoption of a technology should be carefully reviewed to maximize benefits, as was the case with the adoption of the western credit-based educational system.

Therefore, a strategic course for the development of education and science lies in technologies employed in research and learning. Two other important strategic courses are the building of educational capacity to use information and communication technologies and the development of new academic programs. The first course involves training for educators, while the second requires serious efforts to develop educational policy. Both should consider pedagogic and psychological aspects.

[10] *National Human Development Report 2004. UNDP Kazakhstan.*

Box 1.2.3.

New educational technologies and national security

In the context of globalization, the introduction of new educational technologies is particularly important when an improved education system is not only a question of domestic policy but also relates to overall national capacity and, consequently, national security. In 1983 the US Government developed a paper "A Nation At Risk" that drew attention to the need to improve the US education system to bring it up to the requirements of the time. In 1996 Richard Riehle, the US Minister of Education, prepared the first national plan for education technologies entitled "Getting American students ready for the 21st century: ensuring technological literacy". The program provided for computer supply, Internet access, professional training, technical assistance and improved financing of education. This resulted in increased investment in educational technologies on the part of federal government, states, local authorities and individuals, moving the nation forward significantly towards goals related to educational technologies set in the 1996 plan[11].

Access to and quality of higher education are important topics for public debate globally, because tertiary enrolment and quality of higher education determine national intellectual capacity, which is, in turn, key to successful technological development.

However, the links between new technologies and education are not one-way. The intellectual capacity of a society, in particular human capital, is undoubtedly a key factor in technological development.

Human capital is considered the key factor accounting for all sub-systems of innovative development (both economic and social development), while investment in human capital is instrumental to successful development processes. However, it should be remembered that labor only becomes human capital in an adequate institutional and macroeconomic setting.

Globally, the focus is on innovative products related to the 'informatization' of education, the development and promotion of online educational resources, new educational technologies, communication networks, and learning and development-stimulating products. New technologies in education are a key to competitive national human capital which, once established at a high level, contribute directly to enhanced competitiveness in the global economy and are a prerequisite for the country joining the group of developed countries.

New technologies and the environment

Technologies also contribute to environmental management. Modern technologies are used for environmental monitoring, data collection and review, follow-up responses to environmental threats and identification of covert sources of pollution. Also, the government uses technologies to assess existing threats and develop agricultural and industrial policies, ensuring environmental friendliness[12].

Many environmental problems in developing countries are a result of management's low awareness of risks and the low capacity of responsible authorities in assessing environmental threats in advance. New technologies enable researchers and environmental authorities in developing countries to use global databases and information resources to ensure accurate and more informed decisions are made.

Box 1.2.4.

Intellectual capacity and new technologies

New technologies should facilitate knowledge and know-how. In a knowledge-based society education and learning should be continuous. Establishing a system of life-long dialogue education and learning, removing barriers between learning, research and production, promoting creative talents and using all benefits of an information-based society are the integral elements of new technologies and innovation.

Source: Green Paper on Innovation, European Commission

[11] *The US Government strategy to improve the education system and introduce modern educational technologies as a tool to ensure the US national security (retrospective analysis). M.E. Shaikhutdinov, L.R. Skakovskiy. Kazakhstan-Russian University.*

[12] *Rogozhina N.G Environmental crisis in post-industrial world // Post-industrial world: Centre, provinces, Russia. Vol. 1. - M.: MONF, 1999.*

Environmental management is a priority area for the introduction of new technologies

New technologies are effective when setting up environmentally friendly production of goods and services within the respective legal frameworks. However, businesses often avoid using new technologies for such purposes because of related costs and fear of increasing production costs and shrinking market share.

A major source of environmental pollution is traditional non-renewable fossil fuels such as oil and gas. Replacing these fuels with alternative renewable energy sources resources would be a substantial part of the solution to pollution and other social development concerns. In this context, new technologies can play a major role in the development of alternative energy sources such as wind, sun, biomass, hydrogen, geothermal energy and other renewable methods of energy generation.

Using ICT to form an e-government can play an important "democratization" role by providing a new and powerful tool for participation in governance and promoting public-government dialogue

However, new technologies that contribute to the collapse of the ecosystem and cause different environmental disasters.

Therefore, environmental management is a priority area for the introduction of new technologies. The Sustainable Development Concept[13] indicates that to ensure balanced economic, social, environmental and political development Kazakhstan's environmental sustainability index should grow to 25%, while the effective resource management index should increase to 53% by 2024. This can only be achieved through the introduction and use of new technologies.

Box 1.2.5.

Environmental problems in Kazakhstan's regions

Currently, a depressing environmental situation combined with significantly deteriorating health status of the population is registered in almost all regions of Kazakhstan. The most affected areas are: the Aral region; areas affected by nuclear testing at the Semipalatinsk nuclear test site; East Kazakhstan oblast with its peculiar man-made biogeochemical zone with high concentration of heavy metals resulting from continued heavy metal pollution; the Pavlodar-Ekibastuz industrial and fuel and energy complex, with ash from power plants using low grade high ash content Ekibastuz coal being a major source of pollution; southern regions; South Kazakhstan and Zhambyl oblasts affected by emissions from local phosphor-producing plans and the Shymkent lead plant. Zhambyl oblast has a man-made fluoric zone resulting from land subsidence of fluoride compounds emitted by phosphor-producing factories, while since 1985 a number of phlorosis cases have been registered in cattle.

Source: F.B.Bismildin, 'Environment and health in Kazakhstan'

New technologies for the development of civil society

Perhaps the most striking examples of using the benefits of new technologies to accelerate social and economic development have been projects aimed at enhanced social inclusion and accord, i.e. projects enabling better participation of the most disadvantaged groups in society. Obviously, many of the challenges that disadvantaged groups commonly face result at least partly from limited access to knowledge and information. New technologies can help tackle this problem by offering simplified and less costly data collection and review as well as raising awareness among groups with the most limited access to information.

To promote public participation in social life new civil technologies are needed for the following four purposes: a) technologies facilitating dialogue with government; b) technologies facilitating dialogue with the public; c) technologies facilitating dialogue with business; d) technologies facilitating intra-sectoral dialogue.

The Internet also offers individuals and communities in developing countries almost endless opportunities for knowledge and information exchange.

Just like other organizations, government authorities increasingly use the benefits of new technologies to streamline and increase the efficiency of work. For example, many authorities in developed and developing countries are working to make electronic versions of hard copies of documents and records and go as far as to "connect" databases of such documents to make them available to different organizations. Such efforts improve the efficiency of government authorities and ease public access to public documents, information and services.

Using new information and com-munication technologies to form an e-government can play an important "democratization" role by providing a new and powerful tool for participation in governance and promoting public-government dialogue. However, this can sometimes involve important aspects of civil , particularly when personal information is disclosed without the consent of the individual . Nevertheless, new information and communication technologies can make governance processes more open and transparent. Moreover, new technologies can help perform important oversight functions, for example by enhancing public understanding of how tax money is spent on government goods and services.

[13] *Concept of Transition to Sustainable Development for 2007-2024, RK Presidential Decree #216 of 14 November 2006, Astana.*

Box 1.2.6.

Digital library and enhanced civic participation

In cooperation with the RK Human Rights Commission under the President and with support of UN Volunteers, UNDP and UNESCO have developed a multi-lingual digital library of human rights violations reported to the Commission. Through legislative acts and legal advice on frequently asked questions, the library demonstrates how to protect rights using laws.

The National Academic Library with a network of rural and district branches in all 16 oblasts of Kazakhstan hosts the digital library, which can be accessed on the Internet and through verbal consultations with librarians.

The library targets the most vulnerable groups of the population, and initial results came quickly. The oblast libraries requested that the content of the digital library be enhanced. Thousands of law students had access to an effective tool to study sources, texts and structures of legal documents pertaining to human rights. The digital library will be a tool for the public to be engaged in the development of a National Human Rights Plan. Raising public awareness of the law drafting process and incorporation into the e-government from the time of drafting to ratification will help build public trust in the government and make the library a powerful mechanism for the support and protection of rights. In this regard, information and communication technologies (ICTs) will be integral to the every-day life of all people by contributing to all areas of development.

Source: United Nations Development Program

Therefore, new technologies can play an important role in enhancing human capital. However, there should be a suitable environment for new technologies to become an effective human development tool. Such an environment will be studied later.

1.3. Technologies as a human development tool in Kazakhstan

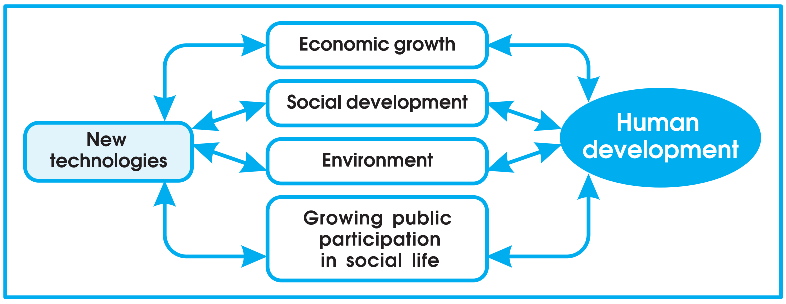
This report treats technologies as a human development tool. At the same time, it has been noted that human development can be regarded as a factor in the development of new technologies. The diagram below (see Figure 1.3.1.) shows the linkages between factors in this system.

The diagram shows that technologies are factors of economic growth, social development, environment and public participation. The ultimate goal of the use of new technologies should be human development. This relationship is shown two-way, because human development, in turn, gives birth to new knowledge and new technologies.

However, a review of new technologies as a human development tool suggests the need for a selective approach to the development, choice and use of technologies. There should be criteria for the choice and use of new technologies in order to promote increased income levels, improved literacy and life expectancy and other human development components.

In addition, national policy determines whether new technologies can be a human development tool. Such policies should aim to[14] :

Figure 1.3.1. Two-way relationship "human development = development of new technologies".



1. provide *creative incentives and new forms of partnerships.* Cooperation between academic establishments, research institutions and the private sector should be encouraged through tax exemptions, subsidies, bonuses, grants, etc.

2. set up *trust funds* to finance research and development. Potential sources of funding of science and technology may include official assistance to developing countries, a re-distributive budget for technological development, write-off of the national foreign debt in exchange for funding of technological development, private funds, and industry.

3. introduce *differential pricing* to help promote goods produced using important technologies and sale at different prices to different countries.

4. ensure *commitment to laws related to the protection of intellectual property and the TRIPS Agreement*

Potential negative effects and barriers to adaptation suggest the need for a selective approach to the development, choice and use of technologies

National policy determines whether new technologies can become a human development tool

[14] *Based on recommendations of the Human Development Report 2001. UNDP.*

(Agreement on Trade-Related Aspects of Intellectual Property Rights, including trade of forged goods).

This will help technologies to become an instrument for meeting human needs. In order to achieve this, in addition to market mechanisms, the government should support the development and promotion of new technologies, since the disadvantaged and low-income groups cannot approach the private sector to invest in the development and introduction of affordable products.

The Human Development Report 2001 suggested a Technological Achievement Index (TAI) as a criterion to assess technologies' coverage of all spheres of life. The TAI includes such components as:

1) development of technologies (measured by patents per capita and fees paid by other countries);

2) spread of new inventions, in particular, the Internet, as well as the share of high and medium level technologies in exports;

3) spread of existing inventions, measured by telephone coverage and energy consumption per capita;

4) skills of the population, measured by years in school and the proportion of tertiary students engaged in natural, mathematical and applied science.

The TAI divides countries into four groups: leaders with national TAI over 0.5, potential leaders with national TAI from 0.35 to 0.49, dynamic implementers with national TAI between 0.20 and 0.34 and marginal with national TAI below 0.20. For example, in 2003 Azerbaijan's TAI equaled 0.420, in the group of "potential leaders". The group of "leaders" includes 19 of the most developed countries. The Report notes that in Azerbaijan there are 2,735 people per million engaged in new technologies. According to the TAI, Azerbaijan is ahead of Central and Eastern Europe and the CIS. Kazakhstan's TAI has, unfortunately, never been calculated. As the absolute leader in technological achievement, Finland leads the world in development and use of new technologies.

National technological achievement is, however, much more complex than the TAI or any other index can measure.

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In conclusion, it is evident that new technologies promote human development. At the same time, human development contributes to the generation of new knowledge and technologies. However, because of potentially negative effects of new technologies and barriers to effective adaptation of such technologies, the choice and use of technologies should be selective.

CHAPTER 2. HUMAN DEVELOPMENT AS KAZAKHSTAN'S STRATEGIC PRIORITY

2.1 Kazakhstan-2030: new human development challenges

2.1.1 Human development through the prism of Kazakhstan-2030

Human development trends in Kazakhstan and the CIS 1990-2006: rapid drop and slow rise

According to UNDP's Global Human Development Report, Kazakhstan and other CIS countries have gone through two phases of human development. The first phase (1990-1995) was characterized by dramatic declines in the main human development indicators, sending Kazakhstan down from 54th to 93rd in the world HDI ranking. During the second phase (1996-2004) the human development indicators slowly recovered, raising Kazakhstan to 79th in the world HDI rank. This, however, is still lower than its 1990 position. A similar trend can also be observed for other CIS countries (see also the dynamics of HDI components and GDI in Annex 2, Table 5).

The trends in absolute HDI figures provided in Global Human Development Reports cannot be compared because calculation methodologies have been changing. For the purpose of the National Human Development Report 2006, the HDI indicators for Kazakhstan have been recalculated using the methodology described in the most recent Global Human Development Report (see table 2.1.1.1.).

This suggests that life expectancy at birth, which is a demographic factor, was instrumental in the decrease of Kazakhstan's HDI over the initial phase. However, it was insufficiently powerful to determine a rise in the HDI over the second phase. Standing at 63.4 years, as the Human Development Report 2006 reports, life expectancy in Kazakhstan is still much lower than in countries with high HDIs (78 years) and most transitional economies (68.2 years). In addition, of note is the great gender disparity in life expectancy in Kazakhstan, totaling 11.5 years in 2005[15] (see also Annex 2, Tables 3 and 4).

Therefore, a decline in human development at the initial stage of transition has resulted in Kazakhstan being in a 'catch-up' position subsequently. The authors believe that Kazakhstan should work to become a country with a high level of human development. To achieve this, Kazakhstan should specify a set of goals to ensure a significant increase in all human development components, including life expectancy, school enrolment and GDP per capita (see also Annex 2, Tables 7-9, 11).

Table 2.1.1.1. Kazakhstan's Human Development Index over 1990-2005

	1990	1995	2005	1995-1990	2005-1995
Life expectancy (LE) at birth, years [1]	68,1	63,5	65,9	-4,6	+2,4
Literacy rate, %[1]	97,7	98,7	99,5	+1,0	+0,8
Enrolment ratio, %[1]	80,0	73,0	85,0	+7,0	+12,0
GDP per capita, USD at PPP [2]	6283	4508	8084	-1776	+3576
Life expectancy index [2]	0,718	0,642	0,682	-0,077	+0,040
Education index [2]	0,918	0,901	0,947	-0,017	+0,046
GDP index [2]	0,691	0,636	0,733	-0,055	+0,097
HDI [2]	0,776	0,726	0,787	-0,050	+0,061

Source:
[1] data provided by the RK Statistics Agency;
[2] calculated by the author.

Demographic factor was instrumental in the decrease of Kazakhstan's HDI over 1990-1995, and was insufficiently powerful to determine a rise in the HDI in 1996-2004

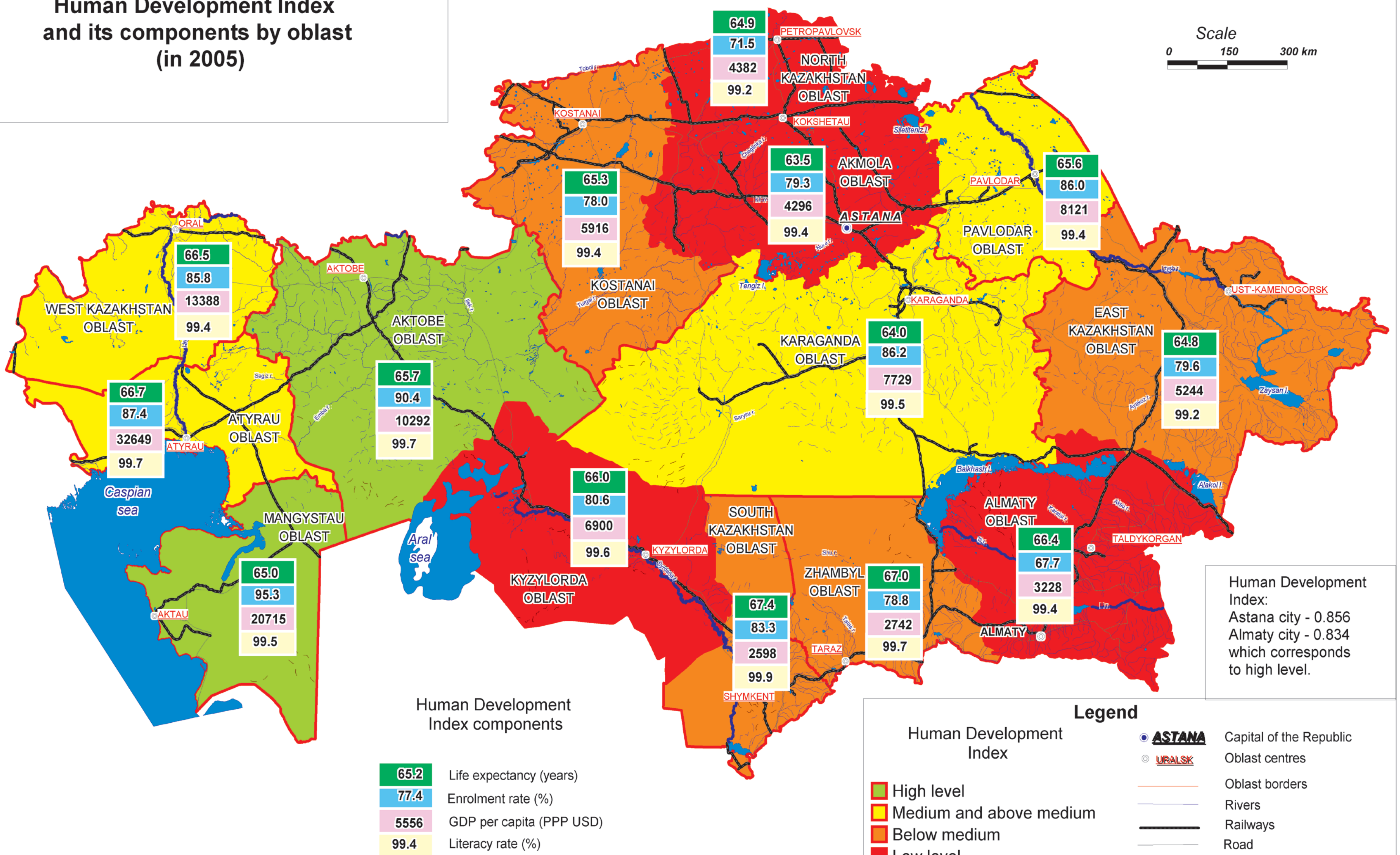
Human development and the Strategy "Kazakhstan-2030": a long-term program for sustainable human development

Development of human potential stands high on Kazakhstan's agenda. New ground was broken in 1997 in recognition of the human development concept in Kazakhstan. The first two national Human Development Reports for 1995 and 1996 were a powerful spur to the use of the concept as a tool for social and economic analysis, resulting in the adoption of the concept as an underlying strategy for a number of national documents, of which the most important is the long-term national development strategy "Kazakhstan-2030".

There is a great gender disparity in life expectancy in Kazakhstan

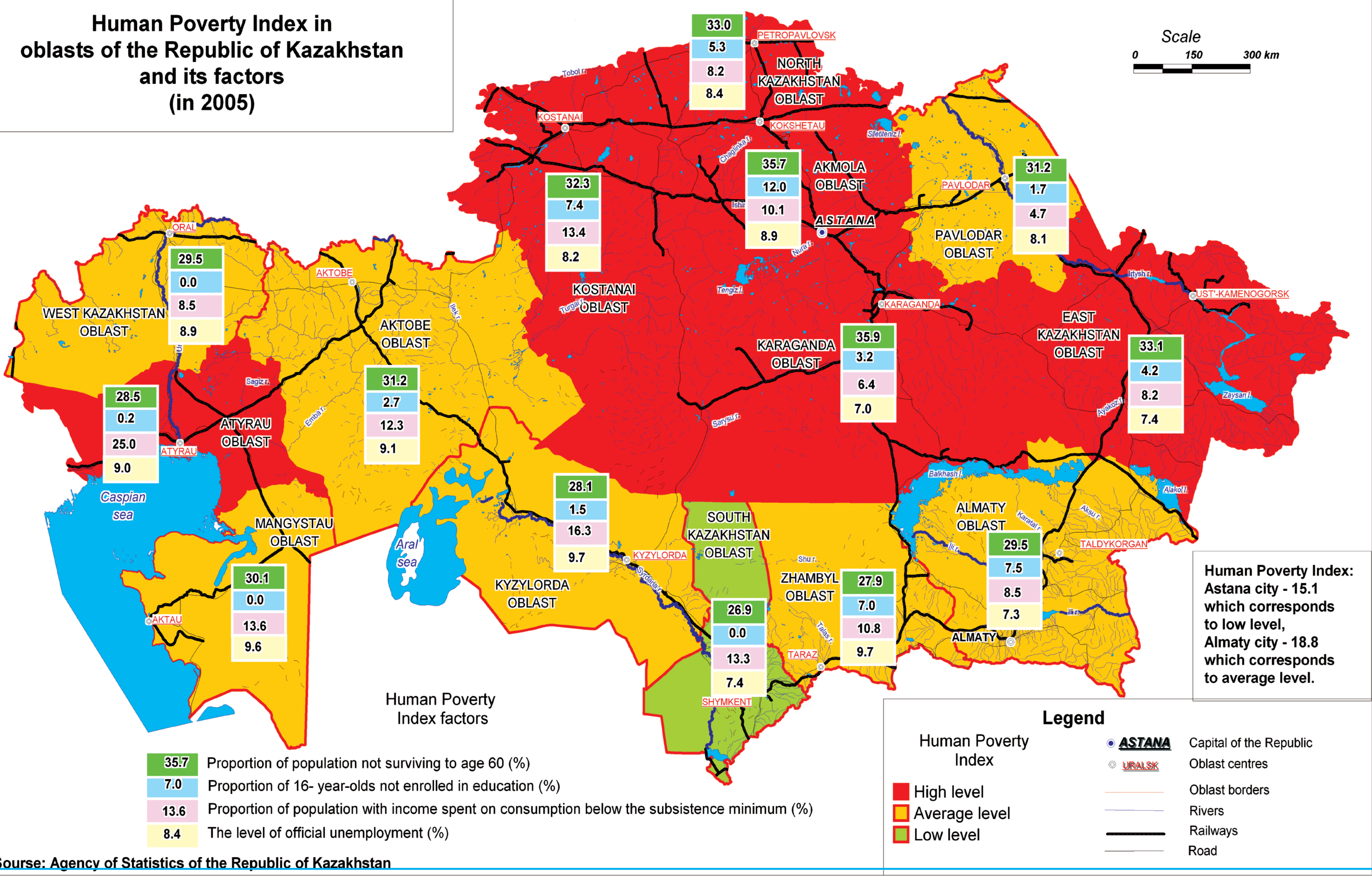
[15] *Demographic Yearbook of Kazakhstan. 2006. Statistical digest / Edited by B. Sultanov. – Almaty, 2006. – 448p. – P.31.*

Human Development Index and its components by oblast (in 2005)



Source: Agency of Statistics of the Republic of Kazakhstan

Human Poverty Index in oblasts of the Republic of Kazakhstan and its factors (in 2005)



Sourse: Agency of Statistics of the Republic of Kazakhstan

"Kazakhstan-2030" introduces on a national level a new paradigm for social and economic development, the highest value of which is people

It is not coincidental that the Strategy is titled "Prosperity, Safety and Welfare of All Kazakhstanis". It is an attempt to introduce on a national level a new paradigm for social and economic development, the highest value of which is people.

The Strategy identifies the following long-term priorities:

1. National security.
2. Political stability and social mobilization.
3. Economic development based on an open market economy with high levels of foreign investment and domestic savings.
4. Health, education and well-being of Kazakhstan's people.
5. Effective use of energy resources.
6. Modern infrastructure development.
7. Professional government.

This shows that the Strategy's priorities center on "health, education and well-being of Kazakhstan's people", which are the basic components of human development. However, each priority contributes to the comprehensive development of human potential.

National security. National security and independence are essential to the sustainable development of any country. As part of this priority, special emphasis is placed on sound demographic and migration policies. Kazakhstan is working to prevent a "demographic crossover" when population shrinks 'naturally' (deaths exceed births) rather than through (net) external migration.

Implementation of basic national security components, namely external and internal security, underlies human development. At the same time, some of these have a direct impact on human development and the HDI. For example, development of rich natural resources leads to growing per capita GDP and, as a result, a growing HDI. Demographically, it is important to ensure a reduction in the death rate and a resulting increase in life expectancy, which will affect national HDI, which is an integral human development indicator (see Annex 2, Table 10).

Demographically, it is important to ensure a reduction in the death rate and a resulting increase in life expectancy, which will affect national HDI

Adopted in 1999, the National Security Strategy for 1999-2005 was an important strategic document in relation to the first priority of the Strategy 2030. It identifies the resolution of pressing social issues as a tool to ensure social and political security. The National Security Strategy gave birth to Poverty and Unemployment Alleviation Program for 2000-2002 and the Poverty Reduction Program for 2003-2005.

Of note is the fact that against a background of the achieved first target of external and internal social and political security, achieving increased life expectancy, which is a major weakness in Kazakhstan's human development, appears to remain hindered. Thus, over 1987-1995, i.e. 8 years, life expectancy fell by 7 years from 70.5 to 63.5 years. A decade later it only rose by 2.3 years, to 65.8 years. Standing at 65.5 years in 1999, it has remained almost unchanged over the last seven years. In this context, ensuring an increase in life expectancy should be a priority human development target.

The Strategic Development Plan of Kazakhstan up to 2010 provides for an increase in the population to at least 16 million, with a rise in male and female life expectancies by four and two years respectively. The first target can be achieved through an increased birth rate and net in-migration, while the second is hampered by a lack of concrete implementation mechanisms.

Political stability and social mobilization. This priority focuses on ensuring social stability and mobilization. The society is divided into different groups sharing political beliefs and religious, ethnic and class interests. The task is to promote national solidarity and national capacity by encouraging various forms of dialogue and reinforcing interpersonal links and relations.

The human development requirements are equal rights, freedoms and opportunities for all, irrespective of ethnic, cultural, religious and class origin and ideological beliefs.

The achievement of the second long-term priority of the Strategy 2030 has resulted in equality of all religions and inter-confessional accord in Kazakhstan. With respect to promotion of Islamic traditions and other world and traditional religions, Kazakhstan is building a secular government as the Constitution specifies. Also, Kazakhstan works to preserve and develop the centuries-old customs, language and culture of the Kazakhs and ensure ethnic and cultural accord and advancement of the Kazakh nation. In this area, the Government has cooperated effectively with the Assembly of the Peoples of Kazakhstan for more than 10 years.

Economic development based on an open market economy with high levels of foreign investment and domestic savings. Although not explicit, human development is part of this priority, which contributes to per capita GDP, which is an HDI component. Therefore, this goal will remain a priority throughout the Strategy implementation period.

Up to 2010, emphasis will be placed on labor intensive sectors, such as agriculture, timber industry, light and food industry, tourism, residential building and infrastructure provision, the development of which will help address structural economic issues, as well as tackle unemployment and poverty.

Economic diversification, mitigation of regional disparities and improved economic performance through better output and reduced resource input, including energy consumption, are important from the human development perspective. This will increase GDP per capita, provided all resources are used effectively.

Health, education and well-being of Kazakhstan's people. This priority has direct human development implications. It aims to ensure that the population live healthy lives in a healthy environment.

To accomplish this, the Government has been working to improve living standards and quality of life through modern high-quality healthcare, environmental management, access to clean water, an improved epidemiological situation, as well as increased, full and timely payments, improved quality of education, employment schemes and targeted social assistance.

It should be noted that to achieve this priority Kazakhstan should achieve four quite ambitious targets identified in the Millennium Declaration adopted by the UN General Assembly in 2000 in New York, which are:

1) between 1990 and 2015 reduce by two thirds the under-five mortality rate;

2) between 1990 and 2015 reduce maternal mortality by three quarters;

3) by 2015 halt and reverse the spread of HIV & AIDS;

4) by 2015 halt and reverse the spread of tuberculosis and other major diseases.

Despite the Government's efforts and growing healthcare expenditure, these targets relating to MDGs 4, 5 and 6 are not on course to be unattained in Kazakhstan.

Difficulties in attaining the first target have been caused by an insufficient downward trend in infant mortality. So far, the infant mortality rate has fallen two-fold from 26.4 per 1,000 live births in 1990 to 15.15 in 2005, while the 1-4 year-old death rate has fallen by less than two times, from 2.0 to 1.1 per thousand live births.

Attainment of the second target does not seem feasible either, since maternal mortality has fallen by only around one quarter, from 55 per 100,000 live births in 1990 to 40.5 in 2005.

The situation regarding the third target looks more disturbing. Registered HIV infection cases grew from 10 in 1998 to 964 in 2005. Although these stabilized somewhat 2002-2004, the figure then grew by 38% in 2005.

Achievement of the fourth target is being hampered by growing TB rates, which increased nationally from 65.8 cases per 100,000 people in 1990 to 147.2 cases in 2005. Other disease incidence rates, such as STIs, as well as alcohol and drug abuse, have also been rising.

Effective use of energy resources. This priority is linked to sustainable human development, where not only the current but also the future generations should have access to human development opportunities. In this regard, the strategy implies effective use of future income generated through the country's rich energy resources.

Kazakhstan's economy and policy over the next 50-80 years will still be determined by the oil and gas sector. According to the State Program of development of Kazakhstan's sector of the Caspian Sea signed on 16 May 2003, by 2015 Kazakhstan's Caspian oil fields will have an annual output of at least 100 million tons of oil, which is two times more than the national output in 2004. Such output will be maintained over the next 25-30 years, while output, and export, of accompanying gas for domestic needs will increase up to 63 billion m3 by 2015.

To ensure proper oversight of these strategic resources, the extracting companies and the Government will join the Extractive Industries Transparency Initiative (EITI). To ensure effective use of oil and gas revenues the National Fund should be replenished and tapped into. This will ensure sustainable human development for future generations.

Modern infrastructure development. To attain this priority Kazakhstan should build a globally competitive national transport and communications complex and promote trade flows via its territory. The strategy has a human development implication with regard to free movement, with better services and potential increases in revenues from automobile production, tourism, services, road and capital construction.

In attaining the priority 'Modern infrastructure development' Kazakhstan has a number of accomplishments: the key port of Aktau was reconstructed; in Semipalatinsk a bridge was built over the Irtysh River; the Aksu-Konechnaya railway line was built, while the Druzhba-Aktogai line and Druzhba station were reconstructed.

Efforts are being made to build a new transport corridor. The Japanese Government is sponsoring a Special Assistance Program to rehabilitate transit highways in Western Kazakhstan.

In communications, an important accomplishment is the introduction of the GSM cell connection systems. Fiber-optic communication lines have been built and satellite networks introduced to install telephones in rural and remote areas.

Economic diversification and mitigation of regional disparities are important from the human development perspective

Kazakhstan should achieve four quite ambitious targets in health area identified in the Millennium Declaration

Modern infrastructure should be further developed in remote areas and the quality of services improved

Modern infrastructure should be further developed in remote areas and the quality of services improved. This will improve the quality of life for both the people of Kazakhstan and overseas tourists.

Professional government. To attain this priority Kazakhstan should target an effective civil service and government that are optimal for a market economy: the Government should be capable of achieving its priorities. A professional government should guard national interests and promote human development based on strategic plans.

As part of the priority "Professional government", short, medium and long-term planning concepts have been introduced. Some structural changes were made to government and the number of government agencies and government staff reduced. To improve decision-making a standard methodology of performance review for the government sector was developed as part of civil service reform.

The concept of decentralization of government responsibilities was developed to promote optimal division of responsibilities and authority of central and regional governments. This will ensure more effective communication and performance of government authorities to achieve social and public goals.

A number of targets within the "Professional Government" priority are yet to be accomplished

A newly introduced model of civil service divides civil servants into political and administrative categories, makes mandatory a competition-based recruitment process for the administrative civil service and improves social and legal protection of administrative civil servants and staffing procedures.

A number of targets within this priority are yet to be accomplished. For example, decentralization of power and delegation of authority to lower levels are yet to be completed and local governance promoted. Regional competition should be reinforced based on the principle of concentration of productive forces where the best resources are and the regions should have more budgetary authority. Anti-corruption efforts should be further intensified and avoid personal and official influence - this will further facilitate human development.

The principal national concept should now be the transition to sustainable development, which is an objective requirement that can realize the long-held dreams of the Kazakh people in terms of national welfare, nature, culture and each Kazakhstani's health and well-being

Therefore, the Long-Term National Development Strategy "Kazakhstan-2030" is a programmatic document aimed at sustainable human development. In order to achieve each of the long-term priorities identified in the Strategy, national and sectoral programs have been developed. A number of targets have been achieved, while others are yet to be accomplished. New human development dimensions are coming to the forefront resulting from today's development context. This requires due attention to be paid to the issues identified and new programs to be developed.

2.1.2 New human development dimensions dictated by a changed development context in Kazakhstan

Since 1998 all national programs have been aligned with the Strategy "Kazakhstan-2030". In addition, as a member of the world community Kazakhstan has committed itself to the goals identified in the Millennium Declaration adopted by the UN General Assembly in 2000, the Agenda-21 goals identified at the 1992 Rio Earth Summit and the goals resulting from the World Sustainable Development Summit held in Johannesburg in 2002.

On the global arena, since 1998 Kazakhstan has been an active member of the UN Sustainable Development Commission, Environment for Europe and Environment and Sustainable Development for Asia initiatives, while in 2003 Kazakhstan joined the regional Eurasian network of the World Council of Entrepreneurs for Sustainable Development.

At the regional level, Kazakhstan is part of the Regional Environmental Action Plan, is engaged in the elaboration of the Framework Convention on Environment for Sustainable Development in Central Asia and supports the development of the Central Asian Sustainable Development Strategy (sub-regional Agenda-21).

At the national level, the National Development Strategy 2030 has given birth to the Strategy of Industrial and Innovative Development to 2015, the Concept of Environmental Security of Kazakhstan to 2015, the Gender Equality Strategy for 2006-2016, the Sustainable Development Council of Kazakhstan, the Kazyna Sustainable Development Fund and the Eurasian Development Bank.

The authors believe that the principal national concept should now be the transition to sustainable development, which is an objective requirement that can realize the long-held dreams of the Kazakh people in terms of national welfare, nature, culture and each Kazakhstani's health and well-being.

Kazakhstan's huge national resources, diverse natural conditions and unique qualities of its people such as persistence, talent and tolerance, make it possible for Kazakhstan to not only join world-leading nations but also be the first example of a "future state", an eco-state retaining and increasing natural capital through national history.

The primary goal should be the quality of life determined by the following three basic components: life expectancy, income and environmental status.

Kazakhstan's life expectancy, the first determinant, is very low, on average 15 years lower than in developed countries. This reduces the life expectancy index by 0.24 and the HDI by 0.08[16]. A life expectancy increase by 13 years would place Kazakhstan 43rd in the HDI ranking versus 79th, i.e. Kazakhstan could be among top 50 countries with the highest HDI.

Income level, the second component, is largely determined by GDP per capita. As the global report suggests, a two times higher GDP per capita would make Kazakhstan's GDP index and HDI 0.115 and 0.038 higher and raise the country 13 places higher in the rank.

Environmental status, the third component, is indicated in the HDI implicitly, since it is determined by a series of human development indicators. MDG 7 has three concrete targets, the attainment of which will require serious effort in Kazakhstan:

1) integrate the principles of sustainable development into country policies and programmes and reverse the loss of natural resources;

2) halve, by 2015, the proportion of people without sustainable access to safe drinking water;

3) by 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers.

These targets can be reached, taking into account the efforts the Government is making. For example forest cover rose from 3.9% in 1995 to 4.5% in 2005, while protected areas increased from 862.8 to 3,463.6 hectares. At the same time, however, the situation is worsening: urban air pollution, pollutant emissions from stationary sources and per capita carbon monoxide emissions increasing after some improvement in 1998-1999.

Despite a reduction in housing water supply provision from 61.4% in 1998 to 54.4% in 2005, the second target can be achieved through the implementation of the Drinking Water Program by 2010.

The third target may be attained through national and local efforts to improve existing houses and provide housing to people with no access to housing.

In addition to these targets, other targets should be addressed in areas where Kazakhstan has great human development accomplishments. Despite high literacy rates and substantial access to education and information, Kazakhstan has low level of public engagement and old-fashioned mentality and sometimes poor indicators in vocational and higher education and fundamental and applied sciences. Also, there are growing economic and social disparities between regions. The legal, environmental and economic awareness of the public should be raised, based on extensive historical traditions, patriotism, freedom, accountability, respect for property and privacy.

The annual messages of the President to the people of Kazakhstan play a course-setting role and set new targets for the Government in the context of a changing environment, needs and challenges.

The President's Address of 1 March 2006 further promoted the message of previous addresses and set a 'super target' of becoming one of top 50 most competitive countries. In this light, in addition to a modern competitive and open market economy, basic components of a prosperous and dynamic society that can be globally competitive include a pro-poor, free, open and democratic society; a constitutional state based on political limitations, checks and balances; religious, ethnic and cultural accord, etc.

All priorities to advance Kazakhstan to become one of the most competitive and dynamically developing countries are, in one way or another, linked to human development. However, the third and fourth priorities, supporting social policy and economic development as well as education and culture, affect human development directly.

The primary goal should be the quality of life determined by the following three basic components: life expectancy, income and environmental status

New targets should be yet addressed in areas where Kazakhstan has great human development accomplishments: quality of education, fundamental and applied sciences; growing economic and social disparities between regions; legal, environmental and economic awareness of the public and etc.

Box 2.1.2.1.

National development priorities identified in the President's Address to the People of Kazakhstan of 1 March 2006

In order to become one of the 50 most competitive countries, the following seven priorities should be achieved:

1. Kazakhstan's successful integration into the world economy as a basis for a qualitative breakthrough in the country's economic development.

2. Further economic development and diversification as a foundation for sustainable economic growth.

3. A modern social policy protecting the most vulnerable groups of the population and enabling economic development.

4. Promoting modern education, continuous learning, training and national culture.

5. Further democratic development and enhancement of the political system.

6. A National Security Strategy adequately addressing present-day threats and challenges.

7. Further balanced and responsible foreign policy based on Kazakhstan's interests and regional and global development trends.

[16] *Each of the three components has an equal share in the HDI. Therefore, the HDI reduction rate is one third of any component reduction rate. In our case: (0.88-0.64)/3=0.24/3=0.08.*

All priorities to advance Kazakhstan to become one of the most competitive and dynamically developing countries are, in one way or another, linked to human development

Therefore, the present development situation leads to the emergence of new human development dimensions in Kazakhstan. The principal idea should be the Concept of Transition to Sustainable Development aiming at a balance between social, economic, environmental and political aspects of national development[17]. This will allow achievement of human development targets for both current and future generations. New targets are emerging in those areas where Kazakhstan has great accomplishments. To achieve the target of becoming one of top 50 most competitive countries, as identified in the President's Address of 1 March 2006, new technologies are to be used to promote human development.

2.2 New national development priorities

Kazakhstan's strategy to become one of top 50 most competitive countries is, no doubt, an important contribution to achieving the long-term development strategy Kazakhstan-2030 and ensuring further sustainable human development. Human potential, in turn, plays a key role in achieving competitiveness. Therefore, these two notions are interlinked and somewhat interdependent.

However, it should be clear that national competitiveness is not a development end. Rather, it serves to attain a more complex goal, which is to provide opportunities for all people of Kazakhstan in all spheres of life, or, in other words, human development.

In this regard, it is important to link competitiveness to human development, conduct a comparative review of Kazakhstan's capacity to become one of the world's most competitive countries and a country with a high human development rank and identify the conditions for improving human potential in Kazakhstan.

2.2.1 Competitiveness as national development priority number one for today

National competitiveness is understood to be national sustainable development capacity based on developing production factors, promoting economic performance and introducing innovations. The Global Competitiveness Report published by the World Economic Forum (WEF) measures competitiveness by two main indexes: Growth Competitiveness Index, developed by Jeffrey Sachs and John McArthur, and Michael Porter's Business Competitiveness Index (BCI) that in turn include component indexes and are based on a number of indicators. In addition, the WEF's 2005 report introduced a new Global Competitiveness Index (GCI) in 2006, which replaced these two indexes.

The new Global Competitiveness Index, combining the two previous indexes, was introduced to measure and compare a variety of factors determining sustainable prosperity, both in the present and medium-term.

Overall, the WEF's Global Competitiveness Report uses more than 130 indicators, component indexes and indexes to measure competitiveness. The major index is the GCI, made up of indicators measuring development of the following nine pillars:

1. Institutions
2. Infrastructure
3. Macro-economy
4. Health and primary education
5. Higher education and training
6. Market efficiency
7. Technological readiness
8. Business sophistication
9. Innovation

These indicators are used to calculate three component indexes:

Box 2.2.1.1.

Components of competitiveness indexes

The Growth Competitiveness Index is made up of three component indexes: the technology index, the public institutions index, and the macroeconomic environment index. In turn, the technology index is based on the following sub-indexes: innovation, technology transfer and information and communication technology sub-indexes. The public institutions index is based on the law and contracts sub-index and the corruption sub-index. The macroeconomic environment index is calculated using the macroeconomic stability sub-index, the country credit rating and government waste.

The Business Competitiveness Index is based on two sub-indexes: company operations and strategy and the quality of the national business environment.

The national business environment sub-index is constructed on the quality of Porter's four forces: factors, demand terms, accompanying sectors, company strategy and competitiveness. The company operations and strategy sub-index describes a variety of company operations such as production process sophistication, the nature of competitive advantage, staff training, willingness to delegate authority, capacity for innovation, etc.

[17] Concept of Transition to Sustainable Development for 2007-2024, RK Presidential Decree #216 of 14 November 2006, Astana.

1) Factors of production (indicators 1-4);

2) Economic efficiency (indicators 5-7);

3) Innovation (indicators 8-9).

Depending on the stage of economic development, these component indexes make up varying proportions within the GCI (see table 2.2.1.1.):

Table 2.2.1.1. Proportions of the GCI's component indexes for countries at different stages of economic development

Economic development stage	Shares of component indexes in the GCI, %		
	Factors of production	Economic efficiency	Innovation
Factors	50	40	10
Efficiency	40	50	10
Innovation	30	40	30

Countries do not jump from one stage to another. There is a so-called transition period. So far, Kazakhstan has stood at the stage of transition from factors of production to economic efficiency. Countries are grouped by development stage, based on their GDP per capita in USD as exchanged by central banks (see table 2.2.1.2). As estimated in 2005, Kazakhstan's annual GDP per capita is USD3,800, which sends it to the second stage of economic development.

The Global Competitiveness Report 2006 places Kazakhstan 67th in the Growth Competitiveness Index ranking out of 125 countries covered, 70th out of 121 in the BCI ranking and 56th out of 125 in the GCI ranking – far ahead of all other CIS countries in each index. In 2005 Kazakhstan was placed 61st, 62nd and 51st out of 117 countries respectively.

2.2.2. Linkages between competitiveness and human development

Competitiveness Index and HDI

A country cannot be competitive without developing its human potential. This is reinforced by the fact the Global Competitiveness Index is based, inter alia, on a country's achievements in health, primary education, higher education and training.

National competitiveness is characterized by over 130 indicators, component indexes and indexes, while the key aspects of human development are characterized by over 150 indicators presented in more than 30 tables annexed to the UNDP's Global Human Development Report. Furthermore, many of these indicators are the same. However, in the competitiveness review such indicators characterize factors of production and efficiency, including an appraisal of human resources as a factor of production, while in the review of human development human resources are considered as a development outcome, rather than as a factor of production.

The human development rankings are based on a number of integral indexes, primarily the Human Development Index (HDI) which is based on the following four indicators:

- Life expectancy at birth;
- Literacy rate (of adult population aged 15+);
- Enrolment ratio[18] ;
- GDP per capita in USD at Purchasing Power Parity of national currency[19] .

The first indicator is contingent on a variety of factors, including those determining national competitiveness, namely development of healthcare and new high-tech human and environmentally-friendly technologies.

The second and third indicators describe achievements and capacity of the education system to ensure access to learning. These indicators depend on components of national competitiveness relating to education, including higher and vocational education.

Kazakhstan has moved to the second stage of economic development – the stage of economic efficiency

In 2006 Kazakhstan ranked 67th in Growth Competitiveness Index, 70th in BCI and 56th in the GCI ranking – far ahead of all other CIS countries in each index

Many indicators characterizing competitiveness and human development are the same

Competitiveness regards human-being as a production factor,whereas human development sees human-being as a primary end of development

Economic development stage	First stage (factors of production)	Transition between first and second stages	Second stage (economic efficiency)	Transition between second and third stages	Third stage (innovation)
GDP per capita, US dollars as exchanged by central banks	<2000	2000-3000	3000-9000	9000-17000	>17000

[18] Enrolment ratio is the total of students of all ages to all people aged 5-24.
[19] Purchasing Power Parity (PPP) of national currency means the number of units of a country's currency required to purchase the same representative basket of goods and services that a US dollar would buy in the United States.

Reaching competitiveness should be seen as a means, rather than an end in itself, to a higher end, which is Kazakhstan joining the countries with high human development

The last indicator varies depending on all components of national competitiveness, i.e. development of institutions, infrastructure, health, education, market efficiency, technological readiness, business sophistication and innovation.

Therefore, reaching the target of becoming one of the top 50 most competitive countries is the foundation on which to build to ensure Kazakhstan's sustainable human development in the future. This target should be seen as a means, rather than an end in itself, to a higher end, which is Kazakhstan joining those countries with the highest human development ranks[20]. This will be time-consuming, since other countries will be developing at the same time.

A comparative review of Kazakhstan's capacity to become one of the 50 most competitive countries and one of the 57 countries with high human development rank

As noted earlier, the Global Competitiveness Report 2006 placed Kazakhstan 56th out of 125 countries covered in the GCI ranking – the leader among CIS countries.

The most troubling situation is observed in health and primary education

Kazakhstan stands 51st in the factor ranking and 56th in the efficiency ranking, i.e. ahead of other CIS countries. However, Kazakhstan, at 74th, comes third in the CIS in the innovation ranking.

The table below shows values of the GCI, three component indexes and nine pillars for the CIS (see Table 2.2.2.1.):

The table shows that in Kazakhstan the most troubling situation is observed in health and primary education that refer to the first group of basic indicators (factors of production). In three out of the nine CIS countries listed the situation in health is better than in Kazakhstan, suggesting that Kazakhstan should pay more attention to this sphere.

Table 2.2.2.1. GCI and its components in the CIS

	GCI	Factor Index	Efficiency Index	Innovation Index	Institutions	Infrastructure	Macro-economy	Health and primary education	Higher education and training	Market efficiency	Technological readiness	Business sophistication	Innovation
Kazakhstan	56	51	56	74	75	68	10	86	51	44	66	72	70
Russia	62	66	60	71	114	61	33	77	43	60	74	77	59
Azerbaijan	64	56	78	70	72	56	17	96	82	81	76	70	63
Ukraine	78	86	69	78	104	69	74	94	48	80	90	76	73
Armenia	82	81	88	93	84	92	71	62	80	104	86	104	84
Georgia	85	82	87	113	78	79	93	61	76	86	106	116	102
Moldova	86	88	85	98	101	85	67	92	73	92	96	93	100
Tajikistan	96	94	103	103	77	108	96	85	98	108	102	110	95
Kyrgyzstan	107	109	102	108	123	103	117	91	79	114	122	105	111

Source: Global Competitiveness Report. WEF, 2006.

Kazakhstan has a relatively low rank in institutional development (75th), infrastructure (68th), technological readiness (66th), business sophistication (72nd) and innovation (70th). However, it is noteworthy that the lowest of the above ranks – institutions – comes second in the CIS, while the best rank is macro-economy (10th).

Kazakhstan's transition from the first to the second stage of development gives more relevance to the first seven indicators referring to the second group of indexes such as market sophistication (62nd), soundness of banks (68th), access to loans (57th) and venture capital availability (45th)[21].

Kazakhstan leads the way in the CIS in a number of indexes describing national competitiveness:

- 17th in pay and productivity;
- 32nd in railroad infrastructure development;
- 44th in availability of scientists and engineers;
- 48th in production process sophistication;
- 49th in quality of the education system;
- 49th in overall infrastructure quality;
- 57th in quality of math and science education.

At the same time, Kazakhstan lags behind in a number of other indexes:

- personal computers (114th);
- foreign ownership restrictions (102nd);
- hiring of foreign labor (99th);
- freedom of the press (99th);
- life expectancy (96th);
- value-chain presence (93rd);
- foreign direct investment (FDI) and technology transfer (89th);
- inflation (86th);
- efficiency of legal framework (85th);
- prevalence of trade barriers (80th).

As is apparent, Kazakhstan is ahead in the rankings of some indicators characterizing human development, such as education and training, but lags behind in the rankings of other indicators such as life expectancy and FDI.

The Human Development Index (HDI) published in UNDP's annual reports is, in our opinion, a criterion to be taken into consideration when reviewing Kazakhstan's capacity to be one of 50 most competitive countries.

[20] In 2006 there were 57 such countries.
[21] Hereinafter, Global Competitiveness Report 2005.

According to UNDP's Global Human Development Report 2006, Kazakhstan's HDI of 0.774 places it 79th[22] out of 177 countries in the HDI ranking, while GDP per capita of PPP USD7,440 in 2004 placed it 74th in the GDP ranking.

This makes becoming one of 50 highest HDI countries an ambitious goal for Kazakhstan. Currently, HDI values in 63 countries are over 0.8, which places them among countries with high human development ratings and this may soon include another eight countries, including Russia, with current HDIs of over 0.79.

2.2.3 Improved human development as Kazakhstan's next strategic priority

In light of the above, Kazakhstan's strategic priority number two should be to join the group of countries with the highest human development level. The estimates below suggest this target can be met as early as 2010.

In 2005 Kazakhstan's GDP per capita was USD8,100 at PPP. With high rates of economic development (over 9%), GDP per capita will grow annually by some USD 1,000 and begin to exceed USD13,500 by 2010. This is the level currently registered in Estonia, which ranks highest in the former USSR as its HDI of 0.858 places it 40th in the global HDI ranking. Estonia has a life expectancy of 71.6 years and enrolment ratio of 92%. Kazakhstan has the capacity to exceed Estonia's enrolment ratio by 2010. However, for the first indicator, given the very weak upward trend, Kazakhstan may not reach Estonia's level even by 2020.

Taking into account Kazakhstan's high rates of economic development, GDP per capita may almost double in 2007 versus 2000[23], with GDP per capita exceeding USD10,000 at PPP (see also GDP per capita in CIS countries in Annex 2, Table 23). There are some twenty countries with high GDP per capita under USD10,000. Therefore, Kazakhstan will not be able to move up more than 20 places, unless, of course, development rates of around ten countries with GDP per capita between PPP USD10,000-13,000 slow down.

Despite this, Kazakhstan will, in any instance, become a country with a high human development rank, since GDP per capita of at least USD12,000 at PPP will allow an HDI value of 0.8, which is considered the threshold for countries with high human development ranks, even if life expectancy and the enrolment ratio grow insignificantly to 67.5 years and 95% respectively in 2010, according to our estimates (see Table 2.2.3.1).

Thus, by 2010 Kazakhstan can reach the current levels of countries with the highest human development ratings. However, all countries will be working to improve their human development situation aiming to fulfill their Millennium Declaration commitments. In this light, we expect Kazakhstan to move from being 79th to only 65th in the HDI ranking.

The present achievements of civilization cannot come true only if desired. Therefore, the following statement made by the President in his Address to the People of Kazakhstan in 2004 should be reiterated: "We would not want to swallow the dust from the departing train of world civilization. To this end, we all need to use all our abilities, and get all the thoughts, energy and intellectual abilities of our people pulling together".

Along with achieving the target of joining the world's 50 most competitive countries, Kazakhstan should ensure further sustainable human development.

As noted earlier, low life expectancy at birth is a major challenge and hindrance to human development. Not only should Kazakhstan work to increase births, but also take care of those already born. In particular, the excessively large 11.5 year disparity between female and male life expectancies should be addressed.

HDI should be a criterion to be taken into consideration when reviewing Kazakhstan's capacity to join 50 most competitive countries

By 2010 Kazakhstan can reach the current levels of countries with the highest human development ratings. However, its rank will most probably increase from 79th to only 65th

Table 2.2.3.1. Estimated trends in HDI and its components in Kazakhstan up to 2015

Year	Life expectancy, years	Enrolment ratio, %	GDP per capita, PPP USD	HDI	Country with identical HDI in 2004	Country's HDI rank in 2004
2005	65,0	90	8060	0,788	Columbia (0.790)	70th
2010	67,5	95	12400	0,831	Cuba (0.826)	50th
2015	69,5	100	18200	0,869	Hungary (0.869)	35th

Source: calculated by the author.

[22] *It should be underlined that in its Global Human Development Report 2005, UNDP significantly reduced estimated life expectancy at birth for the CIS compared to the previous report (by 0.8 – 5.2 years). Internationally compared infant mortality rates are supposed to be much higher in the CIS compared to values registered using the old methodology. Kazakhstan's estimated life expectancy fell by 3 years. Our estimates suggest that in Kazakhstan infant mortality registered according to the WHO methodology is no more than 1.5-1.7 times higher than that registered using the old methodology, which results in a reduction in life expectancy of approximately one year.*

[23] *Our estimates show that with the economic development rate at 9.5% in 2006-7, Kazakhstan's 2007 GDP will be 196% of the 2000 level.*

Indeed, there should probably be a national program addressing this issue.

Also, attention should be paid to addressing the MDG health targets relating to reduced child and maternal mortality and halting and reversing the spread of HIV & AIDS and other diseases. Currently it does not seem likely that Kazakhstan will achieve these targets by 2015. Therefore, work should be continued in the next 15-year period up to 2030.

It is deemed important that extracting companies and the Government join the Extractive Industries Transparency Initiative (EITI). To ensure sustainable human development for future generations the National Fund should be replenished and tapped into.

Kazakhstan's huge natural resources should be used effectively, while non-renewable resources should be conserved and human development opportunities for future generations ensured through renewable resources.

Also, there are targets to be addressed to promote professional government and decentralization. Decentralization of power and delegation of authority to lower levels are yet to be completed and local governance promoted. Anti-corruption efforts should be further intensified.

In addition to these targets, other targets should be addressed in areas where Kazakhstan has great human development accomplishments. Thus, along with the introduction of 12-year schooling and a new system of vocational and higher education, the quality of education should be improved to Soviet period standards and further enhanced, based on the needs both the economy and human development.

Another issue on the agenda is the development of fundamental and applied sciences. The policy of adopting foreign technologies will not make the country a leader. Areas of fundamental and applied science that can provide Kazakhstan a competitive edge by global marketing of local ideas and technologies should be identified and adequate funding of science ensured. The above mentioned issues, as well as other issues related to the development of new technologies will be studied in greater detail in the subsequent chapters.

CHAPTER 3. CURRENT AND FUTURE STATUS OF NEW TECHNOLOGIES IN KAZAKHSTAN

3.1. Kazakhstan's capacity in science and technology

Building national capacity in science and technology is instrumental to achieving high economic productivity through new technologies to ensure human development combined with promoting economic and social welfare. To this end, it is important to review the current and future status of science and technology and look at the role of science and technology in light of human development.

Science and technology implies the acquisition and transformation of new knowledge to address technological, engineering, economic, social, humanitarian and other issues related to science, technology, production and the market as a single reproductive system. Activities in science and technology mainly focus on the *continuous upgrade of the technological base using the latest scientific findings in all spheres of life.* Such activities are result-and-creation oriented and help achieve socio-economic and environmental targets or contribute to traditional social development goals through new technological capacities and tools. Just like any other science-related activity, science and technology embrace goals, methods, outcomes and process per se.

Scientific and technological capacity has many components such as human resources, scientific infrastructure, funding, business participation in R&D, implementation of technological programs by ministries closely linked to and requiring continuously increasing quality of the institutional base, which is understood to be a set of rules, regulations and organizational hierarchy governing the people involved. The determining factor of each component should be productivity (result orientation) and ability to improve and mobilize required resources such as human, material and technological, informational and organizational resources, i.e. everything that can help address national concerns and challenges and have a positive effect on technological and social progress.

To assess Kazakhstan's current capacity in science and technology, the authors identified its strengths and weaknesses. Weaknesses include poor technological capacity of scientific organizations and higher education establishments due to limited funding for equipment and facilities; weak linkages between science and production due to limited use of a market approach in science and research institutions; limited inflow of young scientists as a result of low motivation; poor investment attractiveness of the science and technology sphere nationally. Strengths include Kazakhstan's high literacy rates and people recognizing the importance of education and technologies, as well as the remarkable scientific capacity inherited from the USSR and currently requiring substantial attention and support to be developed for the benefit of Kazakhstani society.

Human resources and science and technology

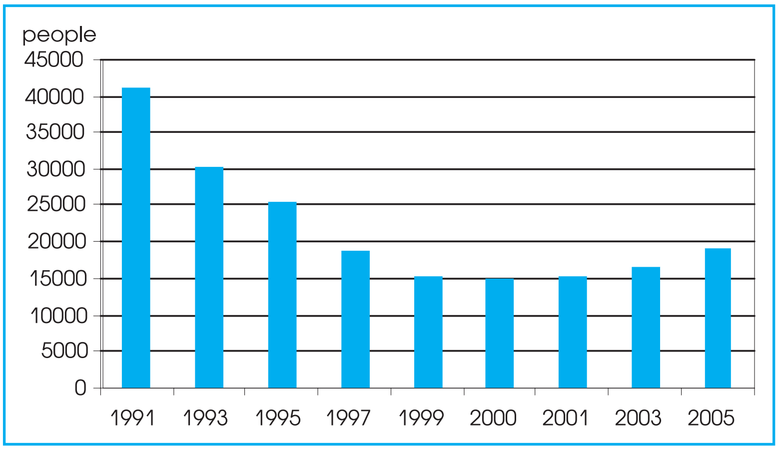
Kazakhstan's human resources in science and technology are characterized by low numbers of highly qualified researchers and engineers, the deteriorating prestige of the scientific profession, and a limited inflow of young talent in science and technology

Personnel is one of the most important components of scientific and technological capacity. Kazakhstan's human resources in science and technology are characterized by low numbers of highly qualified researchers and engineers, the deteriorating prestige of the scientific profession, and a limited inflow of young talent in science and technology.

The structure and composition of the scientific profession have changed substantially since independence. From 1991-2005 staff numbers engaged in research and development fell by 53.8%, from 40,900 to 18,900 (Figure 3.1.1).

The transition period resulted in noticeable deformation of the employment structure in science and technology. Most affected were participants of the scientific process in the governmental sector: from 1991-2005 the number of researchers fell by 56.9%, while support personnel dropped by 68.4%. However, over the last eight years

Figure 3.1.1. Staff of Kazakhstan's research institutions



Source: RK Statistics Agency. Yearbook 2006.

Engineering and technological spheres are paid little attention

staff in international and international/ Kazakhstani research organizations almost doubled.

According to the RK Statistics Agency, in 2005 there were 11,900 researchers [24], or 0.017% of the economically active population, versus 70,000 researchers or 2% of the working population in Finland. In Kazakhstan there are 26 staff engaged in science[25] per 10,000 economically active people, of which only 16 are researchers[26]. In the OECD countries this figure is 6-7 times higher.

In addition, Kazakhstan's science is "ageing". From 2000 to 2005 the average age of doctors of science increased from 55.4 to 58.9 years, which means that just over a half of all scientists of the highest qualification (doctors of science) are of pension age (see Annex 2, Figures 2 and 3).

In Kazakhstan, among scientific organizations, research institutions and higher education establishments predominate, while there is a limited number of design engineering centers, which hampers the development of technological aspects of R&D

As reported by the RK Statistics Agency, in early 2006 the total number of highly qualified researchers was 4,124, of which 1,623 were women. Out of this figure, only 23 were young doctors of science (under 40) while there were 734 young candidates of science. This represents just 0.56% and 18% of all highly qualified staff respectively[27] (Figure 3.1.2).

Against this background, the prestige of the scientific profession has been steadily deteriorating. A survey by BISAM Central Asia conducted in 2005 shows that only 4.3% of the population believed the scientific profession to be prestigious. At the same time, surveys conducted in the USA in 2004 found the scientific profession to be the most prestigious, with 51% of the population finding it extremely prestigious, 25% very prestigious and 20% prestigious.

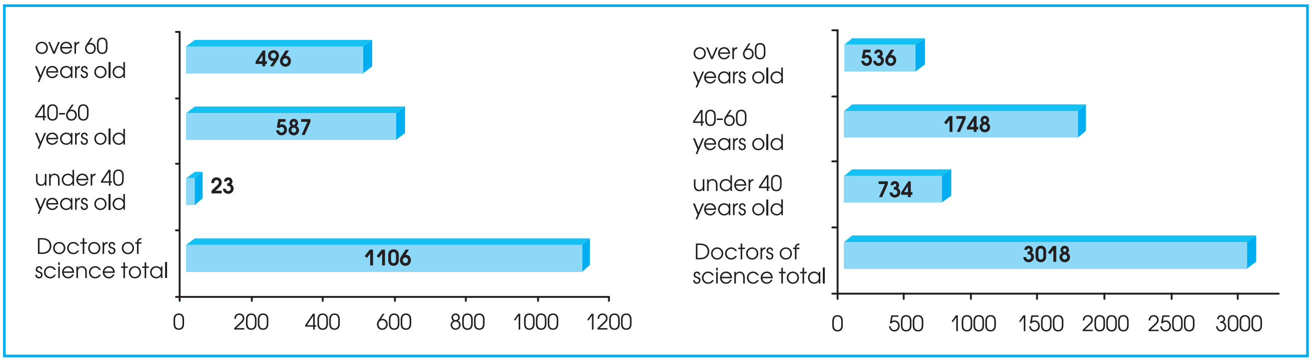
The low prestige of the research profession and limited inflow of young talented scientists and researchers are very typical for the scientific sphere. What makes this even more complicated is that as older researchers leave or retire, they are not being replaced by young scientists due to lack of motivation and interest. There are a number of reasons for this: inadequate remuneration; unstable employment, since many scientists are appointed on medium-term contracts at most, forcing them to seek more stable employment; lack of adequate equipment and service facilities; lack of independent (from top management) decision making by scientists in scientific organizations or higher education establishments; conflicts of interest relating to ownership of end results of research between organizations and individual scientists and researchers.

Recently, Kazakhstan's scientific community has been extensively criticized for low revenues accruing from investment in national science. It is worth noting that the bulk of government investment is in theoretical (unapplied) research and development, in particular at research institutions. The problem is that the state administration system still avoids a result-oriented approach.

In addition, the government neglects engineering and technological spheres. Staff of R&D and engineering centers make up only 5% of all R&D workers or 0.1% of industry-employed personnel. According to available data, the current ratio of scientists, engineers and staff of pilot productions in Kazakhstan is 25:4:1 compared with 1:2:4 in the rest of the world.

This ratio indicates a remarkable lack of highly qualified engineers. This is an important barrier to the development of the scientific-production sector. In addition,

Figure 3.1.2. Highly qualified specialists (doctors and candidates of science), by age, 2005



Source: RK Statistics Agency, 2006.

[24] 11,900 researchers include scientific staff without a scientific degree who are called researchers rather than scientists.
[25] Scientific staff include researchers, support and other personnel.
[26] Researchers are staff directly engaged in research, while they do not necessarily have a scientific degree, such as candidates or doctors of science.
[27] The figure also includes young candidates of science not directly engaged in research

most R&D organizations do not have the required engineering infrastructure, such as engineering and technological services or pilot productions, which would be conducive to the development and implementation of scientific ideas and technologies. In Soviet times research institutions had direct links with production enterprises that conducted applied research and implemented the developments presented by research institutions - so-called "industrial science". With the collapse of the Soviet Union, however, most of these links were broken, causing an outflow of engineers and scientists to different economic spheres.

The majority of scientific workers are still concentrated in scientific and research organizations, which is three times more than in research personnel in higher education establishments (Figure 3.1.3).

The main reason for the limited engagement of the higher education sector in research is that it tends to focus primarily on education[28], which implies less focus on research, resulting in deterioration of higher education science. This is also linked to reduced government funding for higher education, a predominantly fee-based education system, the emergence of private educational establishments and the conversion of state-run higher education institutions into joint-stock facilities against a background of growing competition in the education sector.

In traditional industries such as extraction, processing and transportation of mineral resources, mechanical engineering and some other industries involving science-intensive products and technologies such as instrument-making, informatics, biotechnology, etc., there is an acute lack of highly qualified engineering professionals.

Other negative trends such as the growing proportion of dissertation holders not working in science, an inflexible training system, lack of motivation among research and education graduates and workers to follow a career in science due to low levels of pay and professional support have led to:

– a reduction in publications and patents held by local scientists. Thus, for example, on average 100 scientists produce one article published overseas, while there are only one or two international patents per 15,000 scientists;

– decreased quality of review of research, leading to a sharp increase in the number of degree holders;

– an imbalance between research and innovation capacity and production need in advanced technologies, widening the gap between science and production;

– a lack of competition between scientific schools and individual scientists;

– an outflow of highly qualified staff to the business sector and international science;

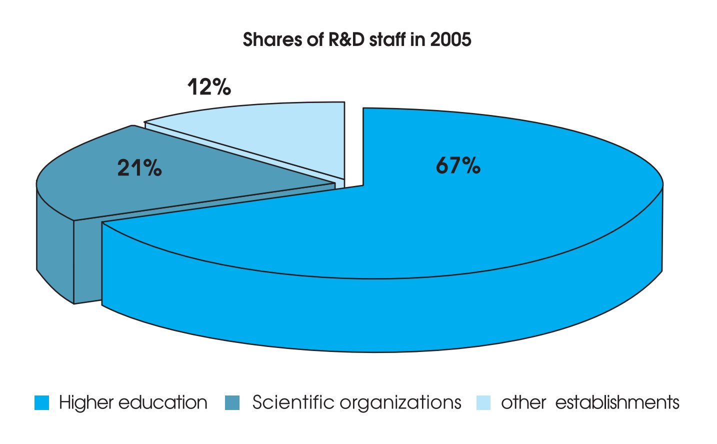
– an ageing scientific, research and education cadre;

– decreasing social status and prestige of the scientific profession.

This indicates the need for action to improve scientific literacy, promote opportunities for developing research as a career for young talented scientists and researchers, as well as to enhance the quality of higher education, particularly engineering education through the integration of science, higher education and business and the promotion of market-oriented research in higher education establishments.

Most R&D work is poorly oriented towards real market needs and requirements

Figure 3.1.3. Distribution of R&D staff in Kazakhstan



Source: RK National Center for Scientific and Technical Information, 2006.

Material, technical and financial base of scientific organizations

In Kazakhstan, among scientific organizations, research institutions and higher education establishments predominate, while there is a limited number of design engineering centers, which hampers the development of technological aspects of R&D. Furthermore, poor material and technical resources, which are an important component of national research and technological capacity, also have a negative effect.

[28] According to a study by the OECD (Draft Examiners Report, December 2006), in 2005 the workload of faculty members in national higher education establishments is up to 900 hours per year, which leaves no time for research. This contrasts with OECD countries where the workload of faculty members is on average 300-450 hours.

According to the RK Statistics Agency, in 2005 Kazakhstan had 390 scientific organizations, following an increase of 133 between 2000 and 2005. This was mainly a result of an increased number of research organizations and higher education establishments. The number of engineering organizations and divisions within industrial enterprises engaged in R&D grew slightly. In 2005 there were only 22 research and engineering divisions within industrial enterprises producing design and engineering documentation, pilot samples and sets of actions to take to the production chain. The national research and technological system lacks design and engineering organizations, whereas on average there is one engineering organization per 16 research organizations.

In 2005 approximately 32.8% or 8.84 billion tenge (versus 53% in 2004) of the overall operating budget for scientific organizations engaged in research and development was spent on salaries and social benefits. The average monthly salary grew six times from 1998 to 2005, to total 57,590 tenge (around USD425) as of 1 January 2006. This ensured Kazakhstan's leading position in this category in the CIS. For reference, in 2005[29] the average monthly salary was 65,598 tenge in the mining industry, 69,905 tenge in the hotel and restaurant sector and 88,420 tenge in financial services. However, these average salaries are still about 10 times lower than in developed countries.

Laboratories of research institutions and higher education facilities tend to have equipment and machinery for R&D that is of poor quality, obsolete or worn-out

The bulk of costs of laboratory equipment and machinery purchased as fixed assets is in state-owned scientific organizations and reached 7,105.7 million tenge in 2005, which is 48.2% of all fixed assets (see Annex 2, Table 17). Scientific organizations tend to have a growing average annual value of fixed assets, mainly as a result of revised book cost of fixed assets.

The proportion of fixed assets for research and development in private organizations and enterprises of mixed ownership grew from 2% in 2000 to 17.6% in 2005.

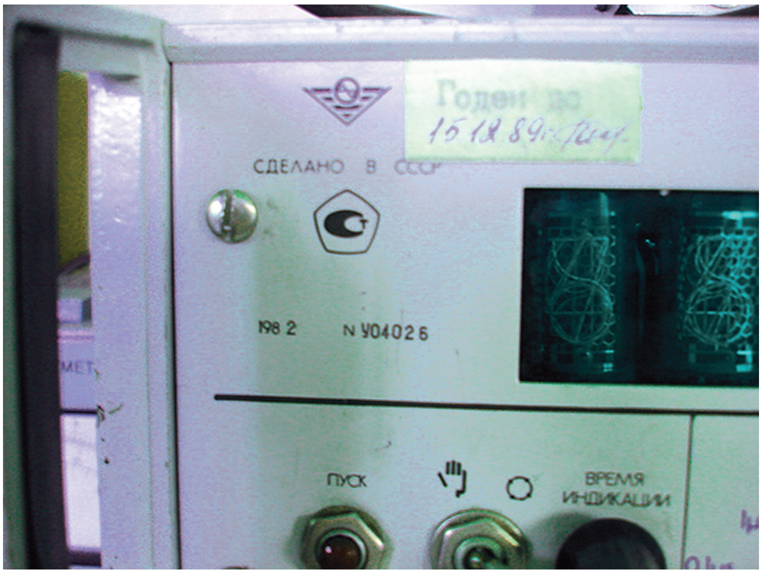
Laboratories of research institutions and higher education facilities tend to have equipment and machinery for R&D that is of poor quality, obsolete or worn-out. From 1993-2005 Kazakhstan purchased almost no new equipment for R&D out of basic funding of the Ministry of Education and Science. Low expenditure on science over the last decade has resulted in only a 4% increase in equipment assets of scientific organizations during 2000-2005.

A report prepared in 2006 as part of the project "Evaluation of material and technological resources of scientific organizations in Kazakhstan" by JSC Center of Engineering and Technological Transfer and commissioned by the National Center for Scientific and Technical Information[30] reveals that:

- the level of equipment used in universities varies significantly. State-owned educational institutions still use equipment that European institutions used 30-40 or even 50 years ago. This is also true about the technical status of buildings and stationary equipment (water supply, sewage system, furniture, basic facilities and utilities such as gas, ventilation, air conditioning and management of used air) in laboratories and offices. In most instances, equipment is completely obsolete and only partially operational. Such institutions can only be used for archiving, since they lack the exceptional facilities to form and train the brainpower that can promote national science and technology;

- the outflow of key scientists overseas is a serious concern that can only be addressed through improved conditions and facilities for research such as purpose, premises, equipment, measurement technology, as well as rewards and bonuses;

- premises accommodating laboratories fail to comply with even one of the safety requirements currently mandatory for laboratories of educational and scientific institutions in Europe.



[29] Statistical Yearbook 2006, RK Statistics Agency, 2006.

[30] Institutions assessed included universities that provide educational services and are engaged in R&D. This is a common practice that can be found in almost all comparable educational establishments around the world. However, in Kazakhstan there are a number of institutes that only work on R&D, specializing in a defined set of disciplines and related research.

Even after refurbishment, some of Kazakhstan's recently refurbished laboratories and offices fail to comply with functional and/or safety requirements.

Development trends in science and innovation

Science and technology programs determine priorities for science. Funding of such programs and the breakdown of R&D by type of research determine innovation. Priorities in science and technology lie in research in engineering science (49% of all R&D expenditure), while only 3% of all R&D expenditure is spent on humanities (Figure 3.1.4).

The proportions of government funding allocations for the above areas have remained unchanged over a long period, which indicates a focus on technology to ensure scientific support to traditional industries in Kazakhstan. Unfortunately, most R&D work in this and other areas is poorly oriented towards real market needs and requirements. Therefore, the quality of R&D remains low and cannot compete with international science-intensive products and services.

Despite the problems, scientists and researchers do conduct research and have even made some technological developments for many industries such as mining and smelting, chemistry and petrochemicals, biotechnology, nuclear and space technologies for different industries (see Chapter 5).

However, only a small proportion of innovative developments and ideas can be used commercially.

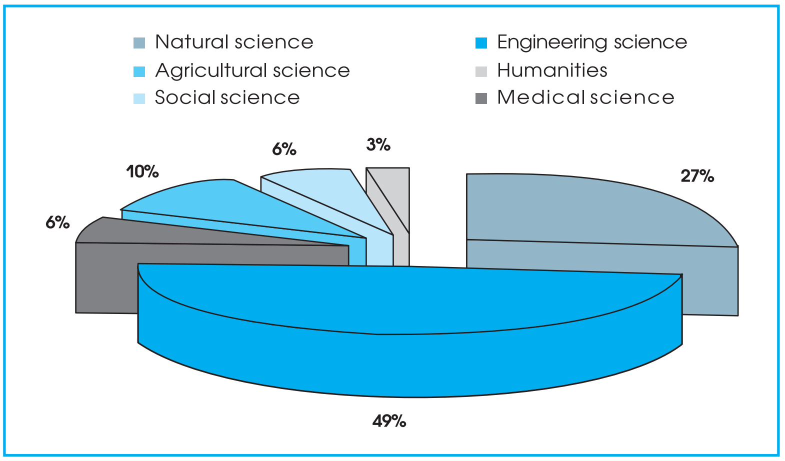
The issue is that there are almost no pilot bases and engineering institutions left. Plus, there are no effective mechanisms for the introduction and development of research findings in the real sector of the economy. Science in Kazakhstan is not sufficiently result-oriented and fails to introduce new products and new commercially profitable technologies into production. Though formally described as scientific, many applied-research organizations conduct almost no research and become exclusively economic entities.

The breakdown of R&D by type of research, such as fundamental and applied research and development averaged for the period 1994-2005 is given in Figure 3.1.5.

Between 2002 and 2005, the proportions changed, with decreased fundamental research, which averaged 21.7%, and increased applied research, which grew to average 76.5% of the total, while in developed countries such as the US and EU, these proportions are stable (Figure 3.1.6).

The level of applied research and development in the USA is higher than in

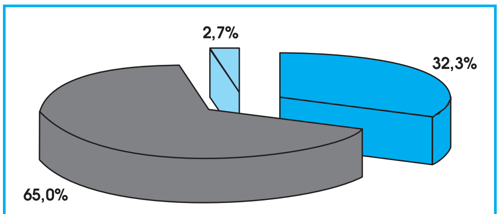
Figure 3.1.4. Priority areas of science and technology, by science, in Kazakhstan in 2005



Source: RK Statistics Agency, 2006.

European countries due to high entrepreneurial activity in R&D and more opportunities on the domestic market to become self-sustainable.

Figure 3.1.5. Breakdown of R&D by type of research, 1994-2005



Source: RK National Center for Scientific and Technical Information under the MoES, 2006.

In Kazakhstan, the proportion spent on development is still some 10 times lower than in developed countries. International practice shows that development requires 10-50 times more funding than research.

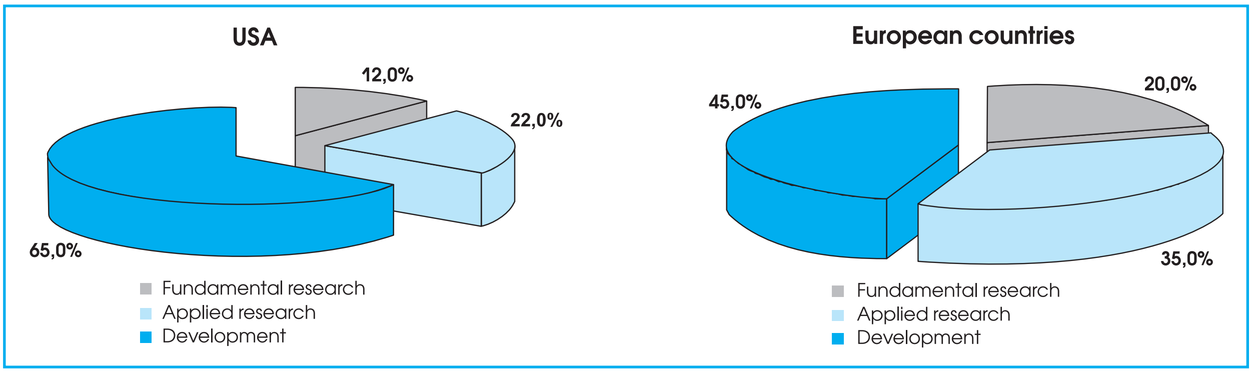
It is commonly accepted that research is only the beginning of the development of a new technology, which also requires:

- development of the professional skills required to learn, use and operate technologies in the context of ever-increasing scientific complexity, productivity and quality of products;
- development of the capacity to design, engineer and manage multiple dimensions of production when maging new technologies and make constant improvements.

At the same time, there is a belief that funding of fundamental science should be growing more in relation to growing funding

There are almost no pilot bases and engineering institutions left and no effective mechanisms for the introduction and development of research findings in the real sector of the economy

Figure 3.1.6. Types of R&D in the USA and EU



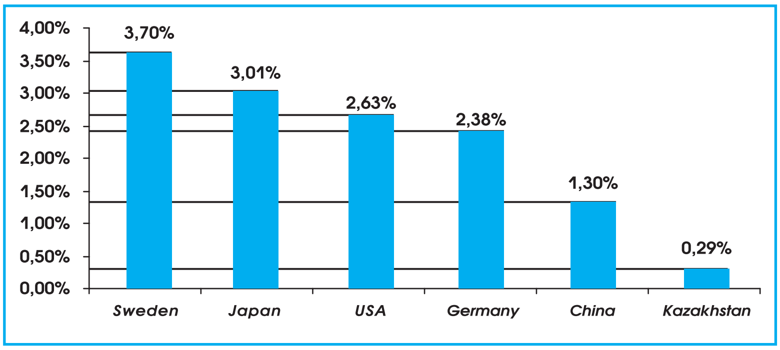
Source: RK National Center for Scientific and Technical Information under the Ministry of Science and Education, 2006.

of science as a whole. Developed countries extensively support fundamental research, which is always on the government agenda. Countries without or neglecting such research are doomed to lag behind, since present-day innovative development is a process of constant gaining of advanced scientific knowledge, which can only be obtained through fundamental science free from the dictates of the market.

In order to speed up innovative processes and development of science and technology Kazakhstan should build its scientific and technological capacity and channel resources into the priority areas of science and technology. In pursuit of sustainable national development, Kazakhstan's main competitive advantages on the global market should be highly qualified and mobile human capital and on-going introduction of new scientific products and services, as well as new technologies. In addition, to raise funds for R&D there should be an enabling environment for businesses to be able to take informed risks related to science and technology.

The major conclusions are firstly that national prosperity can be built rather than inherited and secondly that national and regional competitiveness is determined not so much by a set of factors as by the effectiveness or productivity of the use of such factors.

Figure 3.1.7. Share of R&D expenditure in GDP (2004)



Source: RK National Center for Scientific and Technical Information, 2006.

Funding of research and development

In light of the above issues, it seems important to look at how research and development, which are the main tools for developing science and technology, are funded.

Research and development are funded from the following three sources: a) government funding b) venture funds and financial institutions c) contributions from private and business sources. Combined R&D expenditure over a certain period can be expressed in terms of overall R&D expenditure as a percentage of GDP (Figure 3.1.7).

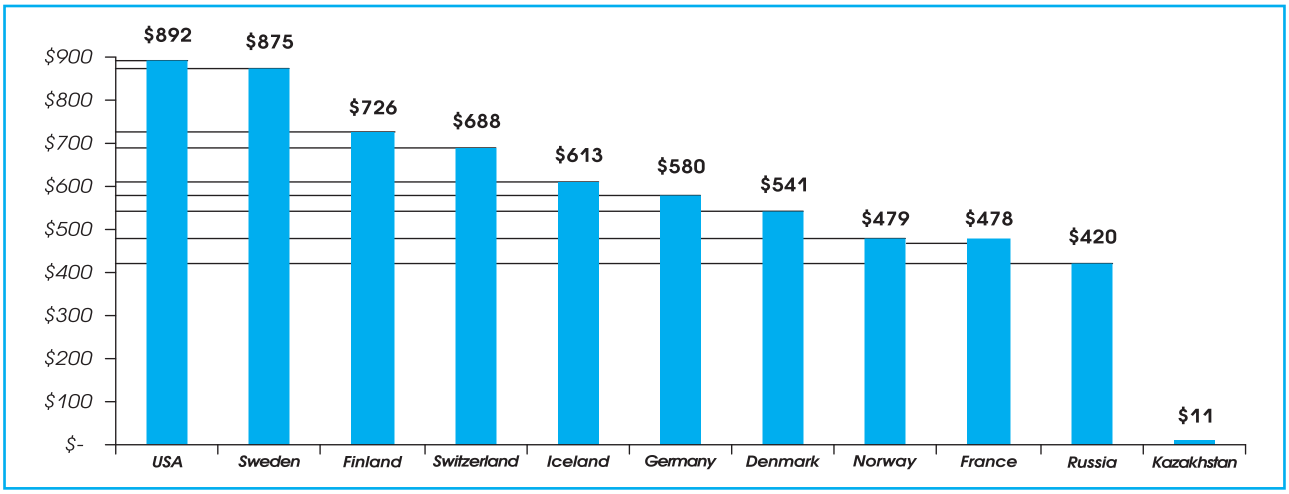
Over the period 2000-2005 Kazakhstan's GDP grew by 1.8 times and the volume of scientific and technological works by 3.1 times. In 2005 the share of R&D expenditure in GDP equaled 0.29% (29.2 billion tenge) versus 0.18% in 2000, which means that R&D expenditure grew both in percentage and monetary terms.

Kazakhstan's annual R&D expenditure per capita was a little over US$11 or 1,416.26 tenge in 2005 (Figure 3.1.8).

The share of internationally exported products and services resulting from new and advanced technologies can be an indicator of the effectiveness of the development of science and technology. Kazakhstan's share is 10-15 times lower than that of Russia.

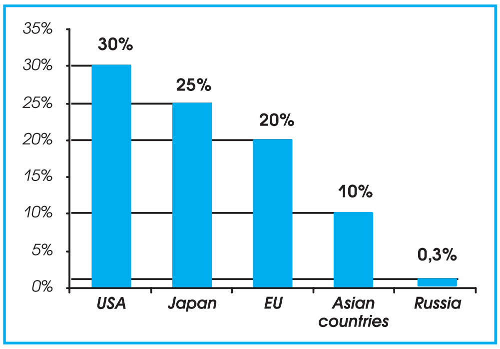
The figures presented above indicate an inadequate level of funding of R&D in Kazakhstan. Studies conducted by the RK National Center for Scientific and Technical Information show that if expenditure on science is no higher than 1% of GDP over a 5-7 year period, then it is not innovative development and this will result in a significant reduction in scientific and technological capacity.

Figure 3.1.8. R&D expenditure per capita



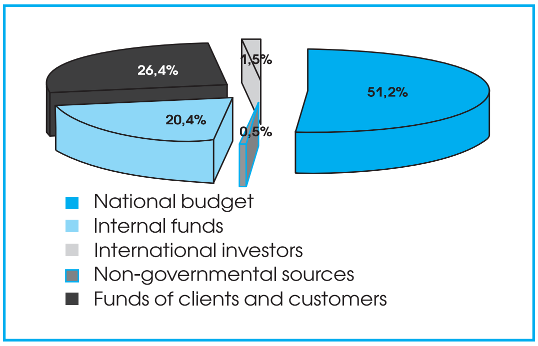
Source: RK National Center for Scientific and Technical Information, 2006.

Figure 3.1.9. Share of products resulting from advanced technologies exported to the international market



Source: RK National Center for Scientific and Technical Information, 2006.

Figure 3.1.10. Sources of funding of R&D in 2005



Source: RK Statistics Agency, 2006.

A review of internal expenditure on R&D by funding sources shows that over the last 5 years Kazakhstan spent almost 3.6 times more government money on science, leading to an increase in the proportion of government funding in the overall funding of science from 41.4% in 2000 to 51.2% in 2005. Funds of clients and customers in the overall funding of science and technology reached 26.4% in 2005, versus 37.4% in 2000, while the percentage of internal funds allocated by enterprises for research and development (20.4%) changed insignificantly (Figure 3.1.10).

As can be seen from Figure 3.1.10, in 2005 98% of all expenditure on science was from three main sources: the national budget, funds of clients and customers and internal funds of organizations, with only 1.5% from international sources.

From 2000-2005, a significant increase in government funding (by 3.6 times) and internal (science and production) allocation (by 3.2 times) was seen in Kazakhstan. This is an indication that, due to competition, enterprises tend to invest more in research and development.

Government funding allocations for R&D

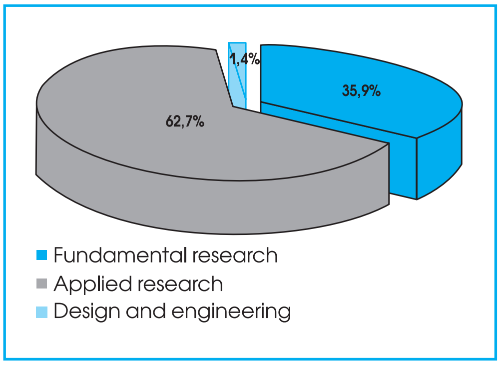
In 2005, the percentage of government funds allocated for fundamental and applied research channeled through the Ministry of Education and Science and sectoral ministries was 50.7% and 48.6% respectively. Between 2000-2005 the volume of completed R&D grew by 4.2 times (including inflation) from 2.086 to 14 million tenge.

A distinctive feature of Kazakhstan's science is that the bulk of government funding, as much as 62.7%, is spent on applied research, 35.9% on fundamental science and only 1.4% on design and engineering (Figure 3.1.11).

Perhaps surprisingly, applied research accounts for almost 63% of government R&D funding. This immediately raises the question of quality and compliance with market and strategic needs, as well as the

If expenditure on science is no higher than 1 % of GDP over a 5-7 year period, then it is hard to think about innovative development

Figure 3.1.11. Government funding allocations for different types of R&D



Source: Data of the RK National Center for Scientific and Technical Information, 2006.

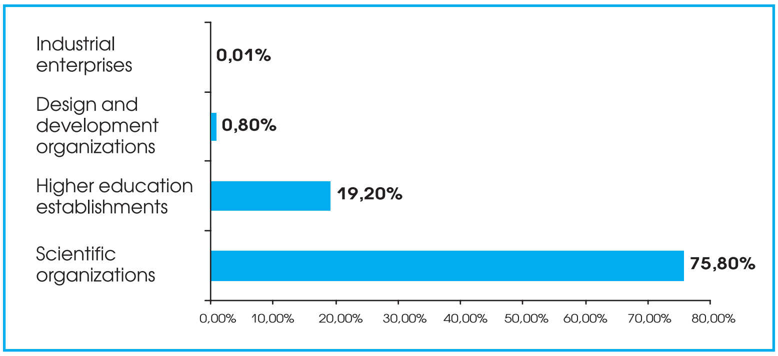
relevance and usefulness of the findings of the funded research. Do the government and ministries use the findings of such research? This question unfortunately remains unanswered, since Kazakhstan does not keep official statistics on the actual introduction of applied research and development into the real production sector. Meanwhile, lack of attention to and inadequate funding of development work results in a situation in which many scientists, researchers and research groups in scientific institutions and higher education establishments have very little funding to build on and take forward such developments.

The EU, South Korea, the USA and Japan all have a different structure of government funding for R&D, which can be presented as follows: 15-20% for fundamental research, 25-30% for applied research and 50-60% for design and engineering.

Government funding for research and development channeled through different organizations is illustrated in Figure 3.1.12.

As the figure shows, most of the research work is concentrated in scientific organizations and higher education establishments. The very small proportion allocated to industrial enterprises and design and development organizations indicates a decline in their R&D resulting from structural changes in the overall post-Soviet system, as well as poor market orientation of these organizations and a shift to other areas (see Annex 2, Table 22).

Figure 3.1.12. Government allocation, by type of organization



Source: RK National Center for Scientific and Technical Information, 2006.

Venture funds

As international practice shows, the capital of venture funds or so-called risk investment funds can and should be major sources of funding of development and innovation. National venture funds enable players of the innovative system, i.e. scientists, researchers, institutions and businesses, to share risks through co-funding of R&D programs and projects. As of 1 November 2005 in Kazakhstan there were 8 venture funds with the National Innovation Fund's share in their chartered capital. Overall, Kazakhstan's venture funds

Box 3.1.1

Government funding allocations for science and technology

Law №135–III of 23 March 2006 specifies the procedure for government grants to promote and reduce gaps between science and production. The Law introduces the concept of "innovative grants", which is a transfer of public money subject to conditions specified in the grantor-grantee agreement. For this purpose, an agent may be involved.
Innovative grants can be given for:

1) design and development work;

2) a feasibility study for an innovative project;

3) patenting of industrial property in foreign countries and/or international patent offices.

Grant awards for feasibility studies and patenting of industrial property in foreign countries and/or international patent offices are competitive and can be made after a review by the state committee for science and technology and financial review of applications. Grants for feasibility studies for innovative projects are awarded if a justification is prepared by an accredited technological business incubator and/or technology park.

Box 3.1.2

According to the Memorandum for the Fund's Investment Policy JSC National Innovation Fund (hereinafter referred to as the Fund) provides grants for applied research and development work in priority areas of industrial innovative development through grant programs with funding thresholds for each project:

- pre-project grants to put together a complete set of documentation required for an innovative project (feasibility study, business plan and other documents) – grant awards of up to 650,000 tenge with an implementation period of up to 6 months;
- small and large grants to complete a research project or make a utility model or invention ready to be put in production – grant awards of up to 7.2 and 3.3 million tenge respectively with an implementation period of up to 18 months;
- patent grants to patent findings of applied R&D overseas – up to 13.2 million tenge with an implementation period of up to 36 months.

own around US$20 million. The National Innovation Fund, funded from the national budget, is a leading venture fund engaged in applied R&D and innovative projects in Kazakhstan.

In order to ensure financial sustainability and a balanced investment portfolio, the Fund has determined thresholds for different investment areas, including applied R&D, of up to 5% of its own capital. In addition, considering the declining lifecycle of science-intensive products, the implementation period for applied R&D is limited to no more than 18 months. The selection of applied R&D is based on comprehensive scientific, technological and economic review and evaluation of the commercial use of R&D results.

The scientific community has widely criticized the Fund's incompetence in scientific and technological review and rejection of R&D projects. However, not all product developers have adequate knowledge to manage and plan the implementation of innovative projects.

Grants are awarded to legal entities subject to conditions which ensure the property rights of the Fund for R&D results. However, despite funding applied research projects, the Fund may prefer not to be involved in the implementation of such projects due to high technological risks, while even if successfully completed, the end result of such projects would be patents, reports, dissertations, or recommendations that cannot be measured in financial terms or be put in production.

Private sector as a funder of R&D

In the majority of developed countries there is more non-governmental than governmental funding of research and development. On average, R&D funding from non-governmental sources in OECD countries grew from 55% in 1981 to 65% in the early 1990s[31] .

The business sector, including large national and transnational corporations, is a major source of non-governmental R&D funding. Historically, in developed countries business corporations have become the most important structures supporting national innovation systems. By funding research and turning research findings and inventions into real products and technologies, they take on economic responsibility for the key areas of scientific and technological progress and provide more funding for science than others in the private sector. The business sector is and will remain a leading R&D implementer, both in terms of expenditure and engaged scientists and engineers.

National venture funds enable players of the innovative system to share risks through co-funding of R&D programs and projects

Meanwhile, Kazakhstan lags behind in terms of the private sector's share of funding of R&D, which stood at 29% in 2004. Moreover, 50% of government funding for R&D does not include incentives for private investment in R&D. In addition, there is no mechanism for government allocation for funding research on topics with the potential to stimulate the interest of the private sector.

Within Kazakhstan's private sector large enterprises engaged in the extractive sector or traditional production have the highest levels of innovative activity. This is because large enterprises can afford to fund R&D due to substantial capitalization of funds, ease of withdrawing funds from circulation and managing high risks to achieve intended outcomes required to improve overall production. The majority of small enterprises only have fixed amounts of funds, which are mainly spent on production and services.

Kazakhstan lags behind in terms of the private sector's share of funding of R&D

However, the innovative activity of Kazakhstan's large enterprises has a number of specific characteristics.

Firstly, Kazakhstan's large enterprises are not really interested in cooperating with national scientific organizations to

[31] *Program for Development of National Innovation System in Kazakhstan.*

Developed industrial countries pay special attention to promoting R&D through raising funds from the private sector and encouraging cooperation between governmental institutions, universities and the private sector

implement R&D. For this purpose, mostly international developers with international patents and experience in project management are contracted. Being internal divisions of large enterprises, local organizations are at most involved in the development of project documentation and budget. Such an approach may affect the future of national science and create a situation in which:

- enterprises are temporarily managed by international owners who are not interested in improving performance indicators and enhancing the com-petitiveness of national products. They may be satisfied with the quality of such products (raw materials) and, therefore, think it unnecessary to spend extra money to improve it for a relatively short term of use;

- Kazakhstan's science is poorly innovation-oriented. The undeveloped market for innovations is explained by both the crisis in production during the 1990s and the inadequacy of research topics, institutional setting and mechanisms to facilitate the responsive of science to the needs of the economy. This is indicated by the fact that growing investment over the last 3 years has not caused a significant inflow of private sector enterprises' own funds into science, since R&D was not widely supported by the government. Government's support is effective in creating an enabling environment for the private and business sectors and co-funding of risky, cutting edge R&D projects;

- The quality of development by scientific institutions and individual scientists is low and issues of funding and material and technological resources for innovative projects are unresolved.

Secondly, primarily international vendors and companies have supplied technological equipment to the above enterprises. This can be viewed as normal only if there are no local machine-building or other plants producing the required equipment. Although Kazakhstan's machine-building industry is not very developed, this indicates some lack of confidence in the quality of services and products produced by local, versus international enterprises.

At the same time, in Kazakhstan large enterprises dominate in the respective sectors of the economy and industry that influence the development of innovation. Large enterprises shape a certain core of innovative development of different sectors and, correspondingly, impact the innovative transformation of such sectors.

A review of international funding practices in applied research shows that R&D requires huge investment and involves great risks, forcing private companies to share such risks with the state. Developed industrial countries pay special attention to promoting research and development. A variety of methods are used to raise funds from the private sector, and cooperation is encouraged between governmental institutions, universities and the private sector.

As the experience of developed countries in raising private sector R&D funding suggests, Kazakhstan should focus on the following direct and indirect incentives:

1) encourage partnerships between the private and business sectors to produce science-intensive products under the following terms: the government invests in R&D, while private investment goes to business development with business corporations entitled to intellectual property rights;

2) improve fiscal policy to provide tax incentives to the private and business sectors.

If the private sector is involved in a project for 3-5 years and the resulting products are commercialized, then the following should be ensured:

1) possible amortization of investment and exemption from investment revenue tax (investment in applied research);

2) deferral of tax on revenues from capital re-invested in applied research.

In order to develop effective schemes of government funding of applied research, with the gradual introduction of cost-sharing by the private sector, the following measures should be taken:

1) institutional reform of applied science through:

– optimization of organizational and legal patterns and a number of applied research organizations and retention of a limited number of advanced organizations to work in priority and breakthrough areas of science and technology;

– promotion of the integration of science, education and the real sector of the economy and a gradual shift from funding of applied research undertaken by state-run research institutions to more direct and indirect support for research tailored to the needs of producing companies and users of science-intensive products;

2) improvement of the legal framework, primarily to ensure rights to intellectual property created with government funding.

***

This review of Kazakhstan's capacity in science and technology leads to the conclusion that capacity is not yet sufficient to implement national industrial and innovation policy effectively. However, the limited export of Kazakhstan's science and technology intensive products and services and the limited scale of the economy do not mean that the nation cannot take an industrial and innovative course of development and make an innovative breakthrough. The issues lie in the funding of research and development and tailoring of science to economic innovation. In order to ensure that investment in social and technological innovation results in broad-based innovative breakthrough in various sectors of the economy and the social sphere, Kazakhstan should ensure a moderate increase in expenditure on science (R&D) to 2.5-4% of GDP and develop human resources accordingly.

Kazakhstan should ensure a moderate increase in expenditure on science (R&D) to 2.5-4 % of GDP and develop human resources accordingly

At the same time, government funding for applied technological research should be minimized and only focus on the most relevant areas of scientific and technological progress from the perspective of economic and social development. This should be complemented by flexible mechanisms of cost-sharing of research and development by the government and businesses and active measures of indirect incentives for science and innovation.

Therefore, the government should support not only long-term breakthrough programs and projects but also areas of science and technology that will have more short term benefits for human and social development and national competitiveness. At the same time, resources allocated for applied research should pursue concrete outcomes.

Based on the above, the following items have been identified as concerns in the area of science in Kazakhstan:

- Inadequate material, financial and technological resources available for research. As reported by Metrology Institute of Kazakhstan, there are only 26 pieces of internationally produced analytical equipment registered in Kazakhstan;

- Limited human resources: the average age of Kazakhstan's scientists is more than 56 years, according to the World Bank;

- Almost zero contact with leading scientists from industrially developed countries. There is a vicious circle of 'scientific tourism' in which scientists attend conferences and workshops as guests rather than participants;

- Allocated resources are distributed to many small scientific and technological programs and projects with very little revenue. The number of patents registered in USPTO is very low, on a par with the poorest countries;

- A limited number of publications in citable journals: in some years no publications at all;

- Poor command of English language, which is an obstacle to international cooperation.

In order to address the above and other systemic issues related to science, international practice suggests the following solutions:

1. Poor focus on priorities in science and technology: there is a need to determine priorities and introduce grants for R&D alongside targeted funding.

2. Use in the private sector: periodically review the needs of the private sector for R&D funding, R&D cost-sharing by the government and private businesses.

3. Improving the quality of science: introduce indicators for revenues from investment and set up a system of independent evaluation.

4. Promoting links with production: set up an information network and technological transfer centers to identify targeted users of available technologies in national and international industries.

5. Ensuring transparent and effective selection and funding of R&D projects: introduce a system of independent selection of projects to be funded through the national budget with open and public disclosure of plans and outcomes.

Direct government funding for applied technological research should be minimized

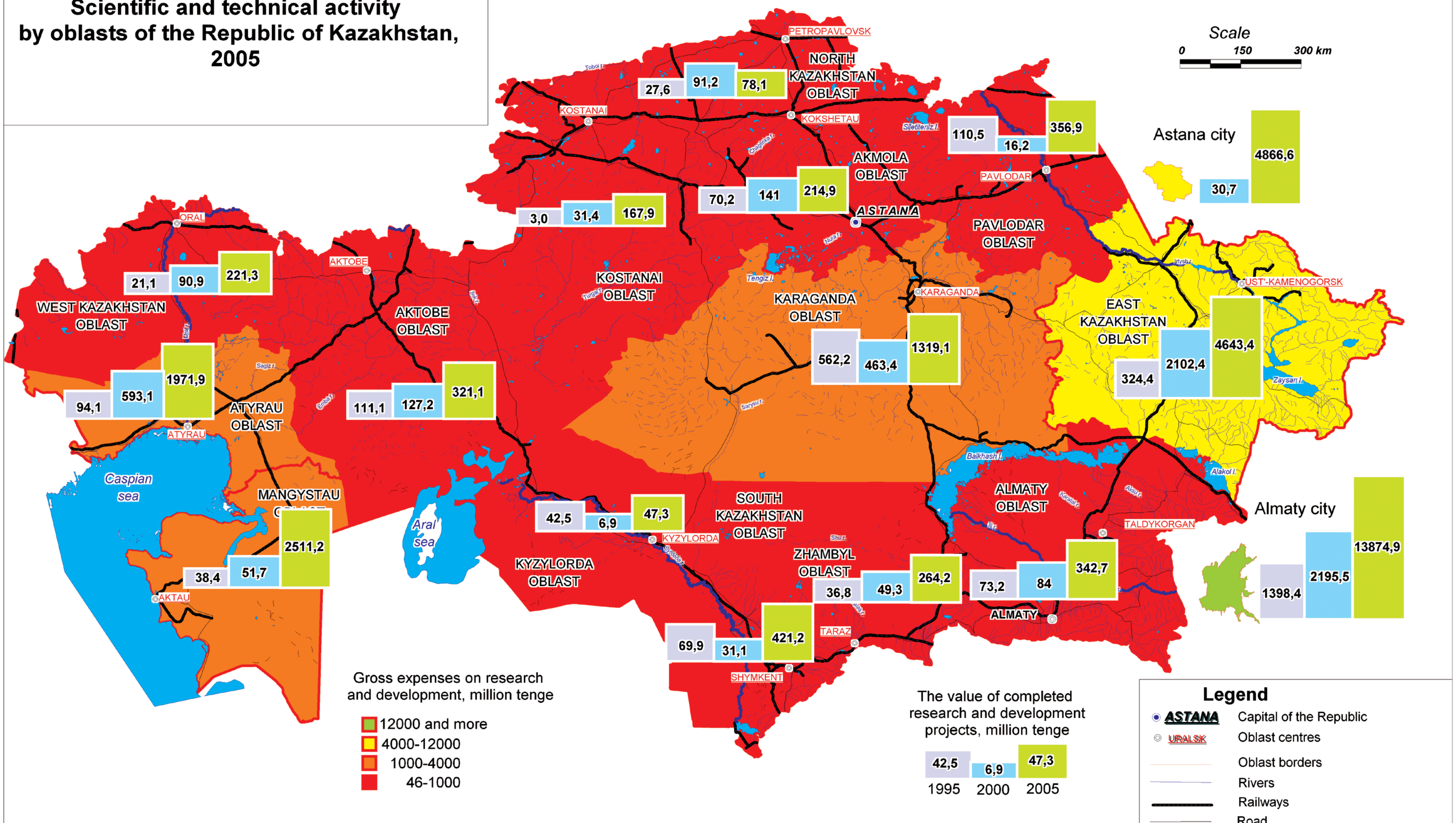
6. Result-oriented focus: plan and coordinate programs and projects, from research to product commercialization.

7. International integration of science and technology: engage international scientists in project reviews, conduct collaborative scientific and technological research and projects and promote the mobility of scientists and researchers.

8. Lack of modern scientific equipment: set up open laboratories and design and development bases; wellequipped student development bureaus in leading universities and institutes.

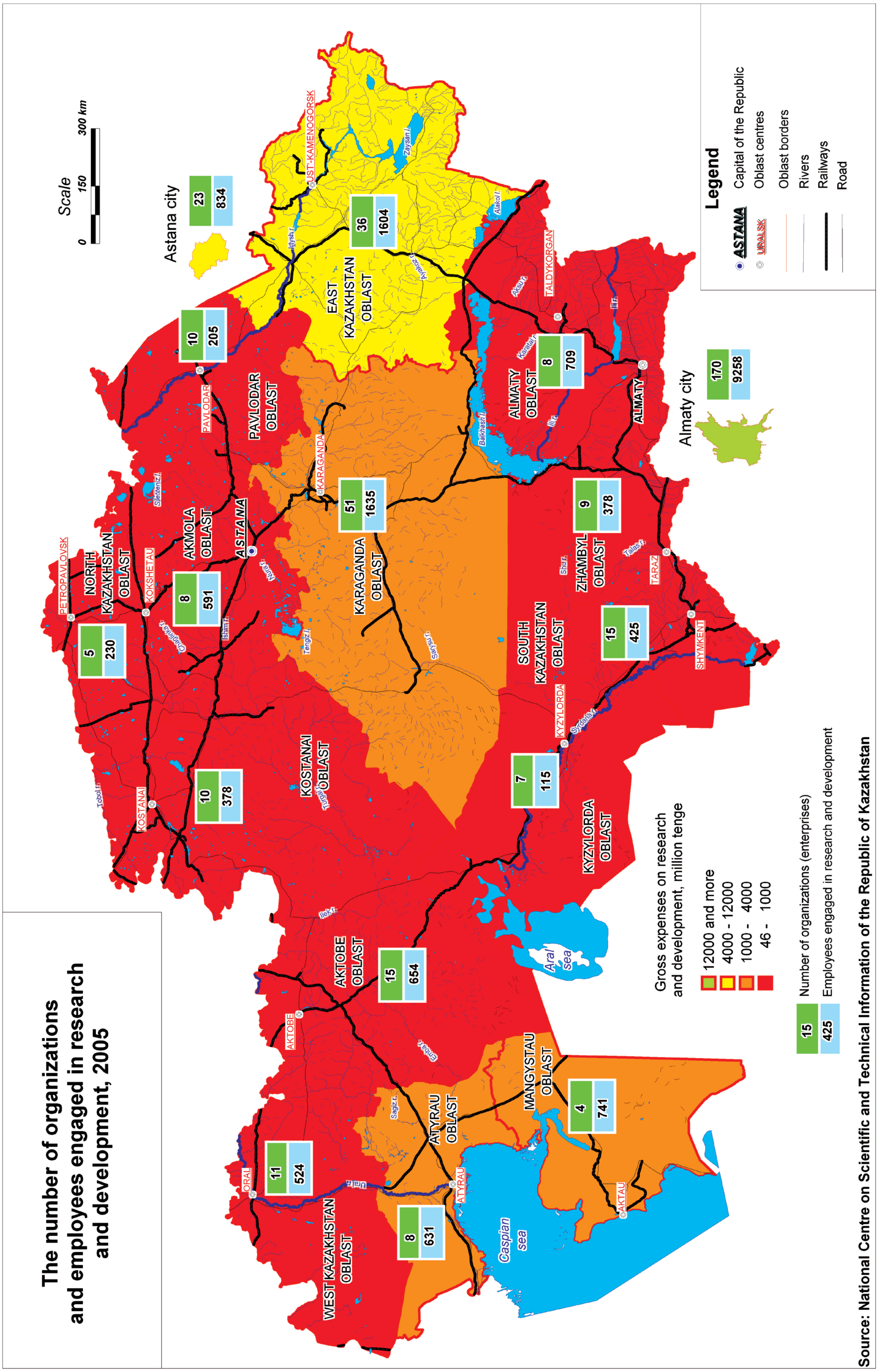
This list only includes a small number of measures addressing the main existing problems and is not exhaustive.

Scientific and technical activity by oblasts of the Republic of Kazakhstan, 2005



Source: National Centre on Scientific and Technical Information of the Republic of Kazakhstan

The number of organizations and employees engaged in research and development, 2005



Source: National Centre on Scientific and Technical Information of the Republic of Kazakhstan

3.2. Innovative business development

Out of 8,000 enterprises only 184 were qualified as innovatively active

R&D development is not the only prerequisite for new technologies. It is equally important to ensure linkages between science and production, with large enterprises, small and medium-sized businesses and innovative businesses being important links. We will go on to look at each link in the innovative process after reviewing the current status of innovative activity of enterprises.

Innovative activity of enterprises

The proportions of new scientific products and the production of science-intensive products in GDP have not been more than 1.1 % and 2.3 % in recent years

Continuous modernization of production based on technological innovation is a source of sustainable competitive advantage not only for business structures and sectors but also for countries that have ensured the dynamically sustainable reproduction of innovative business. Interruption this process of constant upgrading of production leads to loss of competitive advantage for enterprises, sectors and countries. The rate of use of innovations and the response of businesses to innovations created by their competitors feed into their competitiveness. In developed countries over 70% of enterprises create innovations in order to expand their range of products to capture a segment of the market. Reduced production costs are a goal pursued by almost a half of all innovatively active enterprises.

Currently in Kazakhstan there are a limited number of enterprises that extensively use innovations and new technologies. In 2005 the RK Statistics Agency published a bulletin[32] with results of a 2004 survey of 8,000 enterprises using innovation in some way (Table 3.2.1)[33] .

Out of 8,000 respondents (enterprises) only 184, or 2.3%, were qualified as innovatively active. Most such enterprises are in Aktobe, East Kazakhstan, Karagandy and Kostanai oblasts and Almaty city.

The overall cost of innovative products totaled 74.7 billion tenge, of which 64% were exported. The highest proportions of completed innovative products are registered in Karagandy (50.2%), Aktobe (10.8%) and Pavlodar (10.3%) oblasts. These regions also lead in terms of volumes of exported innovative products.

In Kazakhstan the main instigators of innovative activity are large industrial enterprises

Kazakhstan's level of innovative activity of enterprises is much lower than in the EU or even such transitional economies as Estonia (36%) and Hungary (47%). According to the National Center for Scientific and Technical Information, the review of Kazakhstan's scientific and technological development shows that the proportions of new scientific products and the production of science-intensive products in GDP have not been more than 1.1% and 2.3% in recent years. It should be noted that international (5%) and private (3.7%) enterprises produce more science-intensive products than government-owned enterprises (0.6%).

Kazakhstan has the following characteristics of innovative activity:

a) innovations mostly materialize in the form of purchase of new machinery and equipment overseas in most cases, which was reported by 50% of businesses. R&D undertaken by Kazakhstani businesses themselves accounts for only a small proportion of innovations (14% of businesses);

b) Kazakhstan's enterprises are not sufficiently active to gain knowledge from international sources through licensed technologies or purchase of patents outside the country that can only be used domestically (only 4% of businesses);

c) out of 7,212 of surveyed enterprises, only 355 had joint R&D projects, of which 136 were with international partners.

In Kazakhstan the main instigators of innovative activity are large industrial enterprises. This is because unlike small enterprises, large corporations and businesses have financial resources to introduce basic technological innovations. By using the multiplier effect and having good resources, large corporations can afford to introduce new technologies that are important for national economic development. According to global practice, government cooperates with large businesses to set up combined private-public companies to implement certain business projects and programs.

Engagement of small businesses in innovation is a primary and most dynamic structural component of a national market's innovative capacity. Small businesses act as technological leaders in emerging economic sectors and can better promote new market segments, develop new products, improve science and knowledge intensity and competitiveness of production and therefore facilitate new technological structures. In addition, small businesses are important in creating and promoting social technologies at the public level. The high level of effectiveness of small innovative enterprises is explained by their

[32] On innovative activities of enterprises in the Republic of Kazakhstan. RK Statistics Agency. – Almaty, 2005.

[33] The 2004 statistical survey covered all industrial enterprises, scientific organizations and higher education establishments as well as agricultural and building enterprises and computer service organizations with at least 50 staff on payroll.

Table 3.2.1. Main indicators of innovative activity of Kazakhstan's enterprises in 2004[35]

Indicator	2004 г.	% of total
Respondents (total)	8022	
of which:		
With completed innovations	184	
Innovative activity level, %	2,3	
R&D and design and planning divisions	463	
With:		
Staff on payroll, people	6332	
Volume of sold innovative produce (total), mln. tenge	74718,5	100
Including:		
Products newly introduced or exposed to significant technological change	21384,7	28,6
Improved products	48004,1	64,2
Other innovative products	5329,7	7,2
Innovative services rendered (total), mln. tenge	**1917**	
Overall cost of technological innovation (total), mln. tenge	35360,3	100
including:		
From the national budget	1905,9	5,4
From local budgets	10,3	0,03
Personal contributions	32058,6	90,7
Foreign investment	1385,8	3,9
Purchase of machinery and equipment	16005,8	
Research and development of new products	4957,9	
Purchase of new technologies	1700,1	
Purchase of software	292,8	

Note. Based on data provided by the RK Statistics Agency.

rapid response to new scientific ideas and solutions to concrete problems related to the outcome of innovative products.

By contrast, large innovative enterprises tend to be more conservative and slower to respond to new social needs and the profitable transformation of new ideas into marketable products. Despite this, large innovative businesses contribute to the development of science-intensive production and the transfer of technologies important for the national economy.

Later we will explore the barriers to innovation faced by large, medium and small enterprises.

Technological capacity of large enterprises

The majority of local and international developments are introduced in the oil and gas industry, mechanical engineering, metal-processing and light industries[35]. Kazakhstani scientists have developed a number of scientific and technological

[34] *According to the methodology note by the RK Statistics Agency, the survey used such terms as technological innovation understood to be activities related to the development and introduction of innovations, productive innovations embracing the development and introduction of technologically new and technologically improved products, and process innovations embracing the development and introduction of technologically new or significantly technologically improved production methods, including methods of product transfer.*
Kazakhstan's industry, www.mit.kz

[35] *Kazakhstan's industry, www.mit.kz*

Kazakhstan's national industry is characterized by excessively worn-out technological equipment and obsolete technological processes

projects that are at least as effective as similar international projects. In particular, between 1997-2002 JSC Kazakhmys implemented 56, JSC Ispat Karmet 31, JSC Kazzinc 21 (1997-2000) and NOC Kazmunaigas 17 innovative projects. Regarding new technologies, it is worth noting the introduction of a technology for fine precious metals at the Balkhash Mining Factory and construction and operation of the copper wire rod division at JSC Kazakhmys which improved the company's international competitiveness. Ispat Karmet introduced a coated sheet technology in conventional galvanizing and aluminizing, allowing production of new products and ensuring competitiveness of the company.

An example of effective business cooperation between enterprises of different sectors in the production of import-substituting mechanical engineering production and the merger of enterprises through vertical integration can be seen by the fact that a number of local mechanical engineering plants, lead by Kazmunaigas, have started production of new products for the oil sector such as beam units, deep-well pumps, hoist units PAP-40, PAP-50, etc.

This is by no means an exhaustive list of scientific and technological projects developed by Kazakhstani scientists for the non-ferrous metal industry alone is a good indication of the potential national science has.

However, Kazakhstan's national industry is characterized by excessively worn-out technological equipment and obsolete technological processes. This results in low competitiveness of products in terms of quality and realizable value. The re-equipment of technological resources is a long and costly process that requires significant financial and logistical support from the government.

Studies by the RK Ministry of Industry and Trade indicate limited introduction of new production technologies due to lack of financial resources, high economic risks, lack of responsiveness to innovation and lack of information on new technologies and markets. Industries produce almost no high-tech and science-intensive products and there is a lack of reliable information on innovation. Today local producers have no choice but to look to expensive new foreign technologies and equipment in order to modernize domestic production to meet the needs of users. In this regard, the government recognizes the need for prompt intensification of progress in science and technology in different production sectors through local scientific and technological capacity and use of licensed technologies. To this end, the Ministry of Industry and Trade has undertaken a number of studies and elaborated programs of cluster development (over 20 clusters) in different sectors of production. The programs aim to set up high-tech production in key sectors such as mining, oil-processing, chemical and light industries and power engineering at the regional level.

A cluster-based approach to the development of the national innovation system can be more effective in those sectors with large and medium-sized economically active enterprises that influence demand on the market and in the sectors as a whole. In Kazakhstan great cluster capacity exists in mining, oil and gas, building and agro-industrial sectors, as well as transport and nuclear technology industries, with such lead-

Box 3.2.1

Some of Kazakhstan's achievements

The hydrometallurgical method of gold recovery through ion exchange gum developed by the Scientific-Production Association of Industrial Ecology Kazmehanobr has been more effective than international alternatives. Using it in production saves millions of dollars.

As part of the project developed by the Association a gold recovering plant, described as one of the best in the world, was built in the town of Asif in Xinjiang-Uygur Autonomous Region, China.

The National Center for Complex Processing of Mineral Resources developed an unprecedented technology to recover ferroalluminium silicon, which is used at the Ekibastuz Ferroalloy Miniplant, with a production capacity of 3,000 tons per year.

The Non-ferrous Metal Research Institute developed a technology for the separate termination of molten and gas products resulting from the melting of sulphide concentrates of non-ferrous metals. The technology allows significant reduction of losses of non-ferrous metals with sludge. In addition to Kazakhstan, the technology has been introduced in lead plants in Canada and Italy.

The Irtysh copper plant pioneered a technology to process copper and zinc, which was developed by the Institute and patented in many foreign countries.

China plans to buy Kazakhstan's technology to process sulphide lead concentrate. This technology was patented in 14 countries and is used in Germany, Italy, Canada and Bolivia.

ing enterprises as JSC Ispat Karmet, JSC Kazzinc, JSC Kazmunaigas, JC Tengizchevroil, JSC Prodcorporation, JSC Kazakhstan temir zholy, JSC Kazatomprom, etc. Against this background, a cluster-based approach to the development of biotechnology, information technology and the tourism sector, with no economically influential enterprises will involve much risk and significant government costs.

Kazakhstan has the required capa-city to expand domestic production of products and services by creating an environment which enables diversification of production, creation of infrastructure and use of modern technologies and equipment to reduce imports and increase export of domestic output. However, this requires that a number of challenging targets be achieved after a careful review of the barriers in each sector:

- identify priority areas of development of industrial sectors, sources of raw materials and markets;
- saturate the domestic market with competitive local produce;
- develop new technologies and equipment to enable greater production output;
- improve the quality and widen the range of produce;
- increase export capacity of local produce through integration in international markets and productions;
- identify the professional training needs for different industrial sectors;
- take action to enable complete processing of mineral resources in order to increase production of high-tech import-substituting produce and alleviate environmental impacts;
- put in place mechanisms for cooperation and support between government, scientific and project organizations, corporations, private and government businesses.

Structural changes and the overcoming of technological lag are impossible without priority-based development of processing industries, growing production of end products rather than raw materials, development of mechanical engineering and establishment of the fourth and the fifth technological structures.

International practice indicates that high-tech sectors are more responsive to innovation. Therefore, the more science-intensive sectors an economy has, the greater the level of innovation. However, there is a reverse effect when a sector-based economy dominated by extractive industries conducting mainly initial processing actually hampers scientific and technological innovation, as is the case in Kazakhstan now.

Box 3.2.2

Development of the national innovation system

The Program for development of a national innovation system in the Republic of Kazakhstan for 2005-2015 approved by the Governmental Decree #387 of 25 April 2005 identified the following major problems that, if unaddressed, may hinder the development of national innovative capacity:

– most scientific developments of technologies and products are incomplete and cannot be marketed. This greatly diminishes the value of such technologies and products for potential partners

– lack of relevant mechanisms for the introduction and marketing of technological innovation. In the market context, introduction of innovation is closely linked to small innovative business, which is characterized by high risks and large revenues in case of success. Developed economies have a special economic sector ensuring the required environment (infrastructure) for the development of small innovative businesses;

– lack of developed infrastructural elements to facilitate innovative projects such as technology parks and special business incubators; a network of risk-financing funds (venture funds); special financial mechanisms to support businesses at the stage of rapid development; certified evaluators of businesses and intellectual property, etc.

Source: Review of current status and issues related to innovative development of the Republic of Kazakhstan, www.mit.kz

In the current context, macroeconomic stabilization is a necessary but not sufficient condition for economic development. The current status of scientific and techno-logical capacity will not, without government's support, be enough to compete with foreign producers, even on the domestic market.

Therefore, reduced production capacity should be compensated by the introduction of effective modern technologies and equipment, for which more government funding and an enabling environment for more local and foreign investment are required. Otherwise, the gap between Kazakhstan and more industrially developed countries will grow each year.

Overcoming of technological lag is impossible without priority-based development of processing industries, growing production of end products rather than raw materials, development of mechanical engineering and establishment of the fourth and the fifth technological structures

The role of small and medium-sized enterprise in Kazakhstan's innovative development

Small and medium-sized enterprise (SME) mostly operating in services, trade and construction should play an important role in the Industrial and Innovative Devel-

The role of SMEs in Kazakhstan's innovative development has so far been underestimated

opment Strategy and economic diversification. SMEs are particularly important in creating new jobs, generating new business ideas and promoting innovation as well as social and local integration. However, the role of SMEs in Kazakhstan's innovative development and the introduction of new technologies has so far been underestimated, which may be because the SME sector is still under-developed, which limits its technolo-gical capacity.

Today, Kazakhstan has at least 213,300 small and 11,500 medium-sized enterprises[36] (99% of all registered legal entities in 2006) employing over 800,000 staff (or 11% of all jobs). The ratio of staff employed in small enterprises to large corporations is much lower in Kazakhstan than in the EU, the US and Japan.

Many provisions of national SME policy are supervised by the government through legislation and open coordination and then through intermediacy of such structural funds as the National Innovation Fund, the Investment Fund, the SME Development Fund, the Kazakhstan Development Bank and other financial instruments[37] under the Sustainable Development Fund Kazyna, whose divisions can provide direct support to SMEs.

Over the last decade, the government has paid much attention to the development of small businesses by creating a stable macroeconomic environment, developing the domestic market and enabling safer and more transparent cross-border trade, which is of particular importance for SMEs.

In some areas, progress has been impressive:

Consulting and support services targeting potential entrepreneurs wanting to implement their business ideas are a present-day need for Kazakhstan

• sole proprietorship businesses can be set up within two weeks at very little cost, while private partnerships can be set up within two and a half weeks for US$300;

• SMEs have better access to credit resources. Also, in recent years access to start-up capital from private and public sources has become much better due to the improved economic situation and reorganized banking.

The Program for Development of Kazakhstan's Innovation System envisages that by 2015 a dynamically developing and competitive economy will be built with innovative businesses playing a key role. However, based on international good practice the authors believe that the following should be the key elements:

1. Kazakhstani citizens should learn business and innovation skills starting with early age education in special schools and colleges.

Today Kazakhstan has universities offering business and management courses. However, such courses should encourage and support young people, while special training courses should be developed for SME managers.

Consulting and support services targeting potential entrepreneurs wanting to implement their business ideas are a present-day need for Kazakhstan. Such services should provide advice, training, mentoring and other services required to effectively run a business. There is currently a relatively limited range of training opportunities for SME managers and staff. For example, in Finland there are affordable training programs for women, while the South Korean government awards scholarships for potential entrepreneurs from poor regions and runs projects integrating training and practical workshops. EU countries take measures to develop the perception of business as an academic discipline.

2. Prompt and cheaper procedures for setting up a business.

The cost should be the most competitive in the world, while procedures should be swift and free from bureaucracy. There should be an option of online registration.

In order to simplify registration procedures for start-up businesses, a unified registration form should be used and communication with government authorities improved, in particular on taxation issues. Much information should be available online.

There should be special emphasis on simplifying the legal framework, equalizing chartered capital within the group of entities and improving information support.

3. Opportunities for professional learning.

A system should be put in place to oversee provision of training tailored to the needs of SMEs by training organizations. Further, enterprises sho-uld develop internal learning and training schemes, while having access to on-going training opportunities and advisory services.

A major problem that SMEs face is lack of qualified human resources. Kazakhstan lacks a qualified labor force in such vital sectors as information technologies, engineering, etc.

In order to promote training for SMEs a set of measures should be undertaken. For example, the EU, Japan and South Korea

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[36] *Statistical Yearbook 2006, RK Statistics Agency, 2006.*

[37] *These can include, for example, support instruments under multi-year support programs for corporate and individual businesses.*

allow tax exemption to stimulate training of internal personnel and/or hiring of qualified workers; offer unique specially developed courses for SME managers; initiate projects to review skills of SME staff and training needs; identify skill-building structures in the fast growing SME sector and replicate such structures; develop tools to analyze the skills required for SMEs and establish a two-way professional training system.

To stimulate the setting-up of innovative new companies, the following mechanisms, that currently none of Kazakhstan's programs for innovation system development provide for, can be used: 1) creating a unified structure for government funding tools, ensuring access to long-term risk capital and guarantees; 2) setting up special investment companies to provide innovative businesses with start-up capital, which may be too risky for existing venture companies (a so-called Fund of Funds similar to the Finnish Fund Sitra); 3) setting up a venture fund for new technologies and a fund for high-tech companies; 4) putting in place financial structures providing start-up funding for new businesses and instruments of start-up funding for technology parks and business incubators; 5) providing risk loans at low interest rates for start-up innovative businesses; 6) developing two-way guarantee schemes enabling access of SMEs to credit resources; 7) creating loan guarantee funds to provide the guarantees required by financial organizations to stimulate SME credit.

Good information systems should be put in place to provide start-up businesses with information on funding sources. This will help businesses to plan development stages effectively, have access to innovation funding and training opportunities and promote cooperation with their counterparts.

Using loan schemes alongside two-way guarantee schemes will help shorten the gap in funding compared to traditional sectors of the economy. Although run in many countries, the role of such schemes may vary greatly from country to country.

Due to the lack of access to risk capital, high-tech companies should have easier access to loans and guarantee schemes. The best of such schemes should be replicated as best practice.

Building the technological capacity of small businesses

The technological capacity of small businesses should be built with the following considerations in mind. In order to promote SME development to the next stage of development and acceleration of innovative processes and facilitate transfer of technology from scientific organizations to small businesses, initiatives promoting technological cooperation between different sized companies should be implemented, and programs developed to commercialize knowledge and technology and systems of certification and quality assurance put in place.

Cooperation between small businesses, as well as cooperation between businesses, educational establishments and research institutions should be encouraged at the local, national and international levels.

The government should encourage small businesses to apply best practice and best business models. On the other hand, there is a need for coordination to create systems of information and business support to SMEs and set up easy-to-access-and-use networks and services tailored to the needs of businesses.

The government should initiate special programs to raise public awareness of innovative processes and promote dialogue between production engineers, economic agents and their communities

Kazakhstan should have a website as a single point of access to information on business start-up and operation, offering on-line consultations on business operation and providing information on available technologies and developments that can be introduced in production. In addition, standards for business service quality should be developed, including consultations for female entrepreneurs. Similar services are now under development in Russia but have not yet become part of business support services. In European countries, Israel, Japan, the US and South Korea, however, such services are in place and tailored to the needs of domestic and global markets.

Global practices indicate the need to identify and remove official barriers to e-commerce and to promote e-business. Despite a great number of local businesses using the Internet, in reality it is difficult for companies to do business in e-space. At this stage, many companies would think of e-commerce as unsuitable for their operations. In order to demonstrate the advantages of e-commerce, the legal framework for e-commerce should be enhanced, infrastructure built, awareness raised and ICT skills developed.

In addition, the fast growing and successful business sector should have top-class business support services, with the daily practice of thousands of business advisors working mostly on the local level throughout Kazakhstan and the CIS. There are many examples of really top-class business support services globally[38] .

[38] *Creating Top-class Business Support Services, SEC (2001), 28.11.2001.*

The action plan for the Program for Development of the Innovation System should include measures to provide competition-based funding to SMEs and remove unnecessary administrative and legal bar-riers to international fundraising. Special attention should be paid to methods and means of stimulating the development of new companies, including establishing contacts with scientific organizations. The situation will be improved if long-term efforts are made to promote and simplify the use of technological innovation in SMEs and inter-business cooperation and association, i.e. the cluster-based production of goods and services.

Authorized government agencies should conduct systematic research and implement specific projects and activities to promote cooperation between banks/financial organizations and SMEs in order to develop best practice. The action plan for the Program for Development of the Innovation System should include measures enabling access to start-up capital and provide financial support to innovative businesses with the capacity to grow and create new jobs, including those in the traditional economy, through start-up capital funds, incubators and other structures. This should aim to attract investors in the long-term to develop a venture capital industry investing in start-up capital.

Also, it makes sense to consider the following aspects for the promotion of regional development:

- create regional economies based on knowledge and technological innovation to support the least developed regions to put in place competitive instruments and promote partnerships and collaborative projects between the government, businesses, research organizations and universities;
- information community and regional development – support projects on digital technologies in order to reduce the digital divide between regions;
- accentuate the individual characteristics of different regions in order to stimulate them to benefit from their competitive advantages.

The government should initiate special programs to raise public awareness of innovative processes and promote dialogue between production engineers, economic agents and their communities. Special attention should be paid to the mobility of human resources and researchers. This is particularly important in order to share knowledge between sectors, for example, research institutes and industries.

Innovative business development should be promoted to stimulate the innovative activity of large, medium and small enterprises

In order to promote cooperation between research organizations (particularly universities) and industries and facilitate sharing of knowledge and technology, the government should initiate programs helping industrial workers and intellectual property rights specialists to share knowledge.

In practice this can be in the form of expert groups conducting studies to identify and promote best practice in order to facilitate transnational research cooperation and sharing of technology between universities and businesses.

Other mechanisms to support small innovative businesses through government funding allocations can include:

Ensuring participation of small innovative businesses in governmentrun procurement. Studies show that only few small businesses participate in governmentled R&D procurement as well as procurement of other services related to innovative activity. In addition, a set of measures should be developed and put in place to prohibit, without careful expert review, purchase of foreign equipment for government needs if there are local alternatives. The relevance of this measure can be debated but at the current stage when the national budget or resources of governmentowned enterprises and companies are used to complete a development or import commodities for national needs, this measure appears justified.

Support to local companies participating in tenders to supply high-tech equipment. Such measures should include procure-ment for national needs as well as for large local clients. Local and foreign producers should have equal opportunities for terms of payment. Government guarantees may be provided if such measures are applied to large projects, for example in the oil and gas sector.

Innovative business development

In addition to the above, innovative business development should be promoted to stimulate the innovative activity of large, medium and small enterprises. Innovative business entities include businesses and organizations engaged in innovative activities. Not all businesses are classified as innovative. Rather, these are businesses making profits from the development, production, use or distribution of innovative products that may be science or technology intensive products and/or services.

Innovative business operation allows minimization of some expenditure and production costs, i.e. innovative businesses are an institutional pattern ensuring effective cooperation between scientific and technological institutions and private entities on the market and offering knowledge-intensive business services. Innovative businesses become self-sustainable entities if they can reduce costs incurred by scientific and technological institutions and other entities to create an innovative product or commercialize a new technology.

Any innovative activity can take the form of a business and is based on:

- search for and assessment of new ideas ranging from a new product to a new structure;
- search for required resources;
- business operation;
- monetary profit and personal satisfaction with the outcome;

The sources of new ideas for innovative businesses are given below (Figure 3.2.2).

As the figure shows, the leading category is 'Gap in the market', indicating that with the knowledge, time and adequate resources to reach market and occupy a certain niche, potentially huge profits can be made.

In a market economy the development of innovative businesses depends on demand on the part of users of innovation, good scientific and technological capacity of the national economy, operation of venture companies and investors funding risky innovative activities.

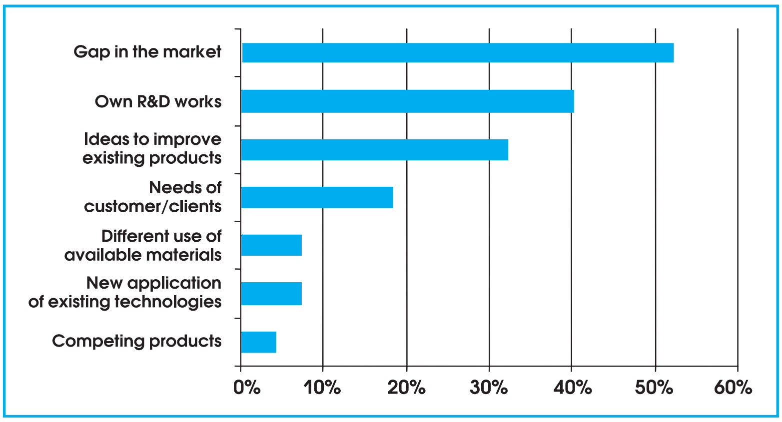
In Kazakhstan the pioneers of innovative business have been youth centers for scientific and technological creation, scientific and technological societies and co-operatives. Such businesses have used the material and technological resources, scientific developments and human resources of scientific institutions and design and engineering bureaus.

Through the promotion of innovative business in Kazakhstan, links between science and technology and production can be established with innovative businesses acting as intermediaries. This ensures almost automatic economic exchange between these two spheres. In addition to making products usable in production through different components of this innovative product, innovative businesses will seek partners capable of meeting a new or latent need within society.

3.3. Bridging the innovation divide and social readiness

The above analysis of Kazakhstan's capacity in science and technology has identified a number of serious barriers to the effective introduction of new technologies for the benefit of human development. Such factors include deterioration of material and technological resources, lack

Figure 3.2.1. Sources of innovative ideas for new technologies



Source: Finnish Foundation for Invention, 2003.

of funding, legislative shortcomings, lack of qualified cadre, etc. standing in the way of economic and social well-being based on the introduction and use of technological commodities.

This section will look at the social readiness and receptivity of society, im-plying government support to ensure the readiness of society in relation to the development, introduction and use of new technologies. In our opinion, such support should focus on overcoming the innovation divide, i.e. ensuring equal access of all population groups to technologies and teaching them how to use them; ensuring highquality educational opportunities for all, which will create a domestic market with a qualified labor force. Attention should also be paid to shaping a unified perception and social recognition of the need for technological development, i.e. developing a new mentality.

Let us look at each of these components of social readiness.

Innovation divide

An important enabling factor for the introduction of new technologies is infrastructure aimed primarily at human development. One of the implications of the introduction of new technologies should be the access of a wide community to technological resources, high rates and flexibility of production and extensive use in all spheres of life.

One of the implications of the introduction of new technologies should be the access of a wide community to technological resources, high rates and flexibility of production and extensive use in all spheres of life

In reality, access to and use of technological commodities is, paradoxically, a dividing line between different strata.

The gap between developed countries and the rest of the world in terms of the development and use of information technologies is growing.

In modern literature, a divide between different countries by which more advanced countries with rapidly deveoping

Box 3.3.1

Technological isolation

Many technologically isolated regions, particularly in South Eastern Asia and Africa, are poor. The major challenges they face are tropical diseases, low level of agricultural production and environmental degradation. To address these, modern technologies should be used. However, difficult economic situations prevent these countries from using technologies: no money to buy technologies, conduct research and introduce technologies with. For poor countries, especially in Africa, diseases and tropical infections are a nation-wide disaster and a serious hindrance to national development. From the perspective of foreign investors, regions with high disease rates have a pernicious influence on the global economy, in particular on technologically isolated countries.

Source: http://www.ibci.ru/konferencia/page/statya06.htm

"Innovation divide" is about unequal access to social and technological commodities that different groups of population may have

information technologies leave other countries behind, or between different groups of population in terms of access to the Internet, other information products and services, is called a `digital divide' .

This Report looks at this divide in a wider sense, as an "innovation divide" going beyond a digital divide and including unequal access to social and technological commodities that different groups of population - rich and poor, young and old and people with and without disabilities - may have. In some countries such groups may also include different ethnic groups and women.

New technologies, first of all, seek to bridge such a divide between different groups and should contribute to improved living standards.

However, technological changes can cause a situation in which some groups without access to modern facilities and commodities of civilization are separated from the elite even further. The proportion of such groups is growing in most countries, including the OECD.

In Kazakhstan the innovation divide lies in unequal regional development

Furthermore, statisticians have found out that almost all new technologies are created in countries home to up to only 15% of the global population, meaning that new technologies reach no more than half of the global population.

In Kazakhstan the innovation divide lies in unequal regional development, leading to unequal opportunities in the use of information and communication technologies among regions, large, medium and small settlements and urban and rural areas.

The technological capacity of Astana and Almaty cities is almost on a par with the average level of European countries, but capacity in the regions remains of much concern.

Computer provision in regional primary and vocational education facilities depends on the financial resources that these educational sectors have (Figure 3.3.1), except for Kostanai and East Kazakhstan oblasts and Almaty city, where expenditure per student is minimal, while computer provision is the best.

Apart from the skills required to use technologies, an important factor limiting regional access to technological innovations is income. Typically, the duration of education depends on a family's income and occupation (Table 3.3.1).

Looking regionally, incomes are highest in Astana and Almaty cities and oblasts with high levels of employment in the oil, chemical and metallurgic industries, while in other regions people have much lower incomes.

Comparison of incomes and tertiary enrolment for 2004 shows that Almaty city is the center of tertiary education, with a 100% tertiary enrolment rate, because the number of students is higher than that of officially registered people of student age. In other regions tertiary enrolment rates are: Astana city – 40.4%, Karagandy oblast – 38.2%, Atyrau oblast – 35% and West Kazakhstan oblast (34.5%) (Figure 3.3.2).

In addition, to bridge the divide, including that between different age groups, training programs should be put

Box 3.3.2

Computers as a tool to reduce the divide

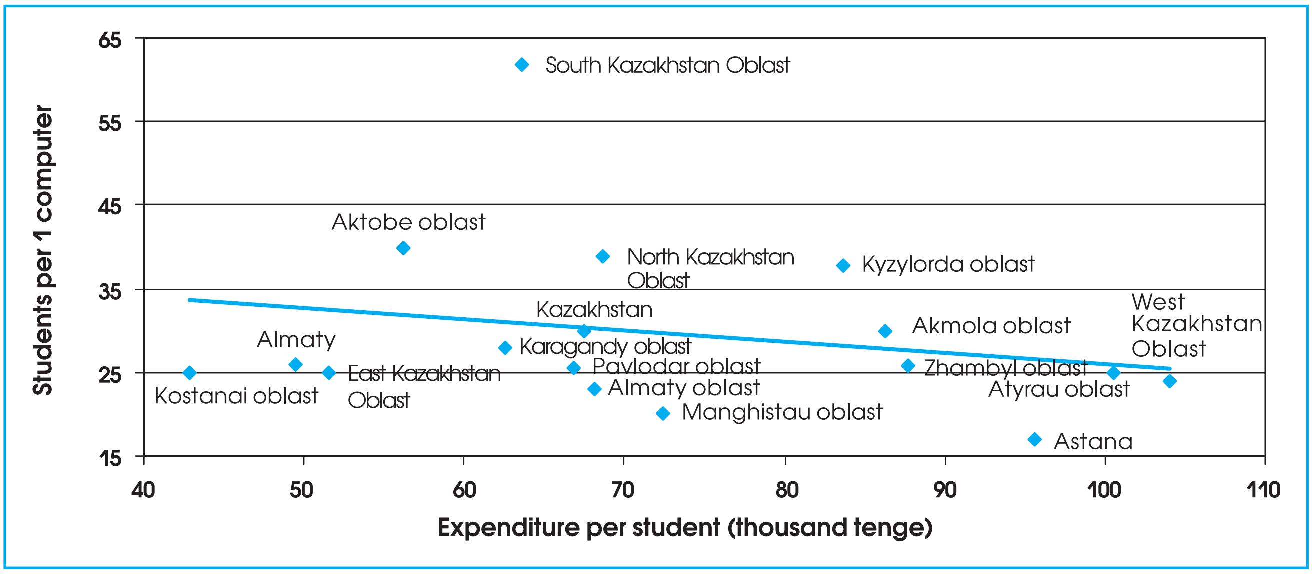
Different developments and research are undertaken to find a solution to the digital divide.

In 2005 the Massachusetts Institute of Technology (MIT) started a program that will develop laptop computers costing less than 100 dollars.

An OLPC is the cheapest computer with free software and low energy consumption. The battery can be charged by turning the handle of a built-in power generator. Users of such laptops can connect with each other using wireless interface and connect to a single access point to share and exchange data.

In Davos at the annual World Economic Forum, Kemal Dervis, UNDP Administrator, and Nicholas Negroponte, a professor at MIT who leads the laptop program, signed a Memorandum of Understanding, according to which UNDP, in cooperation with national and international partners, will develop programs to use such laptops and training resources for schools in developing countries.

Figure 3.3.1. Primary and vocational students per one computer and financial resources



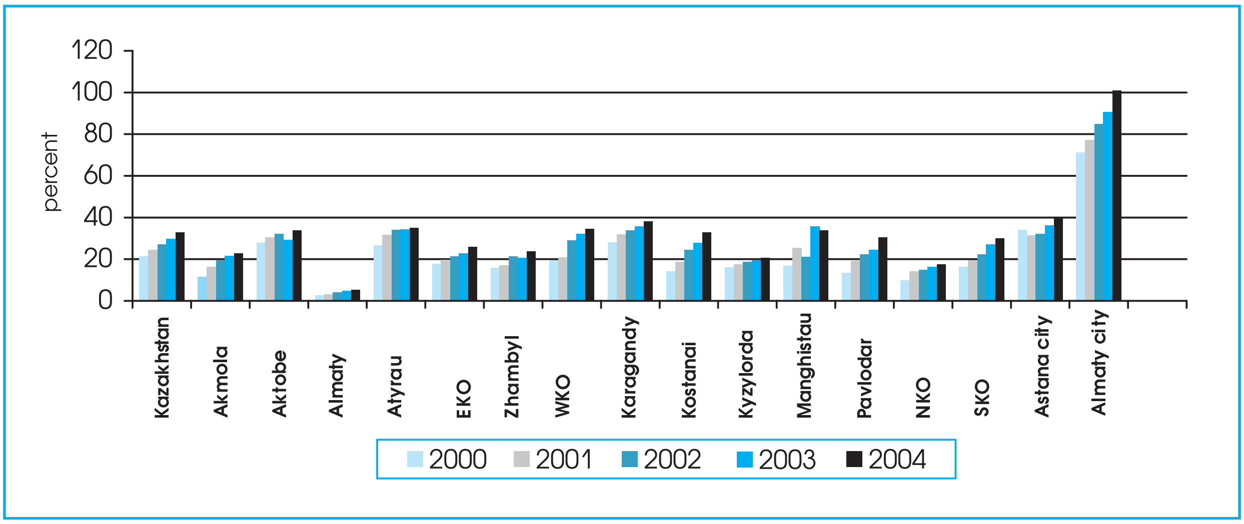
Source: National Report on the Status and Development of Education. 2005. National Center for Assessment of Quality of Education.

Table 3.3.1. Income, by region, in March 2006 (estimated), %

Oblast	Average income per capita (monthly)			Percentage of average national level
	tenge	% of 2005**		
		nominal	actual	
Kazakhstan	17202	123,6	113,5	
Akmola	13508	133,2	122,0	78,5
Aktobe	17181	122,2	112,9	99,9
Almaty	10738	128,9	119,1	62,4
Atyrau	39847	111,5	101,5	231,6
East Kazakhstan	15036	124,8	116,6	87,4
Zhambyl	9304	127,5	119,2	54,1
West Kazakhstan	17657	113,1	105,2	102,7
Karagandy	18576	125,9	115,4	108,0
Kostanai	13204	119,8	110,8	76,8
Kyzylorda	12837	126,5	116,1	74,6
Manghistau	40653	117,2	107,8	236,3
Pavlodar	17073	118,9	110,0	99,3
North Kazakhstan	13978	128,6	118,4	81,3
South Kazakhstan	8848	127,7	117,3	51,4
Astana city	35572	126,2	113,8	206,8
Almaty city	32965	124,9	111,6	191,6

Source: RK Statistics Agency

Figure 3.3.2. Tertiary enrolment, %



Source: National Report on the Status and Development of Education. 2005. National Center for Assessment of Quality of Education under the RK Ministry of Education and Science.

The need for technological re-training of older people becomes evident

in place to train specialists of industrial enterprises, businesses and farms, to give them the skills to use new technologies in production and everyday life.

Maintaining and developing the intellectual capacity and re-training of older people will help to bridge the digital divide and prevent long-term unemployment in people of older age.

Growing productivity and technological revolution are causing the steady deterioration and ageing of once professional skills. In this context, the need for technological re-training of older people becomes evident.

In order to prevent long-term unemployment in older people, a number of measures are recommended. These include re-training or advanced training of pre-pension age staff (aged 45-55) with obsolete qualifications and skills, in order to update them with skills matching present-day needs; flexible working arrangements for older people such as part-time or home-based jobs or short-term contracts, to widen the range of working options and enhance their well-being (see also unemployment dynamics by regions in 1999-2005 in Annex 2, Table 13).

Table 3.3.2. Qualification and age breakdown of staff engaged in research and development, people

Researchers	Total	Age groups				
		under 30	31–39 years	40–49 years	50–59 years	60 +
Workers engaged in research and development as of end 2005, total	1,8912	4,284	3,855	4,556	4,148	2,069
Of which, researchers	11,910	2,635	2,323	2,824	2,575	1,553
Of which, with a degree:						
доктора наук	1,106	1	22	199	388	496
из них женщин	245	1	7	65	94	78
кандидата наук	3,018	136	598	849	899	536
из них женщин	1,378	77	328	433	399	141

Source: RK Statistics Agency.

Table 3.3.3. Breakdown of researchers by areas of science in 2005, people.

Researchers	total	Including women	Including those with a degree			
			Doctors of science		Candidates of science	
			total	Including women	total	Including women
Total	11,910	6,013	1,106	245	3,018	1,378
including:						
Natural sciences	3,515	1,960	359	76	1,001	539
Engineering sciences	3,584	1,570	189	24	513	133
Medical sciences	1,479	875	228	83	492	290
Agricultural science	1,609	620	146	11	527	147
Social sciences	1,090	668	84	25	300	161
Humanities	633	320	100	26	185	108

Source: RK Statistics Agency.

Gender is an important factor to consider when working to ensure public access to training services and technological achievements. Gender disparities are obvious in the scientific and technological sphere (research and areas of science), clearly seen in tables below (Tables 3.3.2, 3.3.3).

Career development for women engaged in the development and use of new techniques and technologies is difficult due to the "technological" nature of research, which is traditionally viewed as a "male" area. Science involves a great deal of manual work such as making, modernizing and fixing experimental techniques. This requires skills to use machines, install, assemble, weld, etc. Women do not have the skills of metalworkers, turners, or electricians, which puts them behind men. However, women with good theoretical education and intellect use this to cooperate with men on a mutually beneficial basis when one party is responsible for all technology-related aspects in creating and adjusting the experimental complex, while the other deals with a program of experiments, review of findings, mathematical modeling and writing of scientific articles and reports.

Good results of R&D require, first of all, deep multi-dimensional knowledge and good intellectual capacity, which women do as well as men and sometimes exceed men in terms of persistence, diligence and interpersonal skills, for example. Therefore, to ensure equal rights and opportunities for both genders, cooperation should be based on partnership and mutual benefit.

In November 2003 Kazakhstan adopted the Gender Policy Concept to promote gender equality and achieve the Millennium Development Goals. The Concept outlines national gender equality policies in the medium-term, up to 2010. Also, the National Commission approved the Strategy of Gender Equality in the RK for 2005-2015, which addresses gender equality through legislation, social policy, social and political life, economy, health, counteraction of violence against women and children, trafficking, information policy, culture, science and education.

It is our sincere belief that mainstreaming gender in national science and technology policy can build a basis for greater scientific and technological achievements. This requires multigoal policies that will promote equality between men and women.

Mainstreaming gender in national science and technology policy can build a basis for greater scientific and technological achievements

Training of qualified personnel

Being competitive on the modern labor market is largely dependent on how well workers can acquire and develop skills that can be used in or adjusted to various situations. Today, success in a professional and social career is impossible without readiness to use new technologies that change approximately once every five years, and adjust to the changing working environment and address new professional challenges (see also Annex 2, Table 16).

Today, success in a professional and social career is impossible without readiness to use new technologies that change approximately once every five years

It is important that national policy is conducive to human development and based on justice. Unemployment and unequal access to technologies bring huge costs to society, both at national

Table 3.3.4. Unemployed people by education in 2005, %

Urban population	Rural population
Higher – 4.8	Higher – 3.2
Incomplete higher– 13.4	Incomplete higher – 12.0
Vocational – 8.6	Vocational – 5.2
Primary vocational – 8.6	Primary vocational – 6.4
Secondary general – 14.9	Secondary general – 8.2
Basic – 14.0	Basic – 7.9
Primary – 17.8	Primary – 6.2

Source: RK Ministry of Labor and Social Protection.

level (lack of support to production, lack of qualified cadre, idle production, reduced tax revenues due to under use of labor resources, etc.) and at the personal level (personal challenges, loss of income, loss of qualifications over the period of unemployment, discomfort and a reduced sense of usefulness).

Today's situation on the labor market is characterized by a steady downward trend in the unemployment rate through a growing number of new jobs and growing economic activity of the population based on economic development. According to estimates of the RK Statistics Agency, the unemployment rate for the third quarter of 2006 reached 7.5% versus 7.8% in the third quarter of 2005.

A more educated population is more adapted to using new technologies in production

However, alongside unemployment (see Table 3.3.4) demand for highly qualified personnel is growing and qualification requirements intensifying, resulting in more job openings. Higher qualification requirements are caused by changing production techniques and technologies and growing quality standards for new products, particularly those exported to the global market.

Currently, Kazakhstan's capacity to increase production and develop services through increased employment and use of new natural resources is becoming more and more limited. Therefore, intensive factors become more important for economic development: better qualified personnel, improved productivity and efficiency of materials and equipment are determined by the use scientific and technological achievements in different economic sectors.

On the domestic market there is a great need for specialists with knowledge of international standards, foreign languages, overseas work experience, experience with international companies and new oil and gas technologies, as well as construction and industrial workers.

As a rule, the training courses and equipment offered by today's higher education establishments and colleges are obsolete and cannot serve as the basis for training of personnel for modern technology-intensive industries.

Also, Kazakhstan should work on a training system for qualified trainers and consultants for educational establishments specializing in training and consultation of innovation specialists. This should target the creation of regional teams of professionals capable of providing high-quality education and effective consultation for the introduction of new technologies and innovative management.

The most important resources for new technologies include intellectual capacity, scientific knowledge, management techniques and methods, business capacity, innovative qualities, and the professionalism of personnel of all levels and occupations.

What is important for Kazakhstan's transition to innovative development is a corps of qualified specialists in science and technology, industry and business who are capable of promoting the outcomes of research and development to reach the market of science-intensive products and also apply these outcomes in industrial and business innovations.

Special attention should be paid to bringing higher education up to global standards and addressing staffing issues, including engaging young people in science.

A more educated population is more adapted to using new technologies in production. Of principal importance is the step-by-step education of young people through which the most talented young people are selected to work in science and generate new ideas.

This means education of young cadre, a so-called creative group of the population that has the capacity to develop and introduce new technologies. This group includes scientists, highly qualified IT specialists and managers aware of and receptive to the use of new technologies. This group is important for two reasons. Firstly, they are people with the creative capacity to innovate, make discoveries, act as experts and promote an innovation-based approach to technological and other challenges. Secondly, this group serves as a basis for the re-production of society's creative potential, acting as role models and directly ensuring re-production of the cadre through education[40] .

The country should encourage and reward talented young researchers, develop them professionally and promote their creative and professional initiative and engage them in research through different grant programs, international scholarships, and competition-based selection of projects.

All of these measures should aim to develop intellectual capacity and promote the prestige of research and development.

In addition to deep knowledge of the research topic and the required material, financial and information resources, young specialist need to know innovative management. This requires training of the managers and staff of small businesses, managers of innovative projects, specialists of technological companies and innovative structures such as technology parks, innovation and technology centers and technological advance centers, specialists on legal protection and commercial use of R&D outcomes, marketing of high-tech products, strategic development of science-intensive companies, technological assessment of innovative companies and scientific establishments and assessment of innovative activities.

Currently, it is impossible to disregard the negative implications of the market evolution of education.

Factors hampering the capacity of Kazakhstan's educational system to train students in innovative practices include lower quality of education, violation of

Box 3.3.3

Supporting science and research

There are a number of organizations supporting science and research in the FSU . These include, INTAC, CRDF, ISTC, etc.

INTAC stands for an independent International association established by the EU and some non-EU countries to support the much-valued scientific capacity of the CIS countries through cooperation with Western Europe. INTAC's mission is to support advanced CIS scientists through funding of scientific projects.

CRDF stands for American Civil Research and Development Foundations, which is a non-profit organization supporting science and technology cooperation between the United States and the FSU.

ISTC stands for International Science and Technology Center that works to give scientists and researchers specializing in armaments, particularly those with knowledge and skills in the production of weapons of mass destruction and rocket systems, an opportunity to re-orient to civic activities.

Box 3.3.4

Almaty City Akimat holds a student competition for best innovative developments

The Almaty City Akimat initiated an open student competition for best innovative developments. To compete, a project should be aimed at commercial use of research findings relating to the technological development of Almaty, production of science-intensive import-substitution and export-oriented produce. The competition is open to students submitting projects that can be completed within two years, with preference given to projects to be completed within a year. The total amount to be granted is USD100,000 divided into 5 grants.

Panorama, 29 December 2006

Box 3.3.5

Vocational education policy

Each country has specific approaches to addressing vocational education issues in national policy. German policies are largely based on social concerns. The German government supports higher education programs that teach skills required to set up innovative businesses.

The Netherlands and Belgium (Flanders) ensure high quality education that will enable graduates to participate equally in international science and technology related programs.

Great Britain (Wales) focuses on promoting the prestige of engineering professions, which results from policies attracting advanced international companies working in mechanical engineering and electronics to the country.

[40] *Social factors of innovative development of the Russian economy. http://www.hse.ru/temp/2006/files/20060404-06/20060406_chernysh.doc*

Kazakhstan's higher and vocational education systems fail to meet present-day requirements to train qualified specialists with research and innovation skills and promote the development of science and technology

institutional selection criteria and evaluation of students, growing corruption in the admission process, etc. Another hindrance is the crisis in the vocational education system.

In summary, it can be stated that Kazakhstan's higher and vocational education systems fail to meet presentday requirements to train qualified specialists with research and innovation skills and promote the development of science and technology.

Within the next few years Kazakhstan may face problems of reduced oil and mineral resource extraction and declining importance of hydrocarbon materials for technologies of the new development cycle. To avoid such a scenario the country should form an innovation reserve and train highly qualified personnel capable of shifting the emphasis from raw materials to innovation and technology based industries.

Mentality and attitudes should be shaped in relation to national technological development as part of work on the receptiveness of society, extensive involvement and recognition of the need for this process

The system of general and further education should address staffing issues as well as develop a variety of human capabilities. Not only will the transition to new technologies determine the structure of Kazakhstan's economy in the future but also the overall future of the country.

Therefore, one of the most important innovation development targets from the point of view of training of qualified personnel is to ensure that specialists engaged in innovation and making scientific discoveries, qualified trainers, managers and consultants create, introduce and use new technologies and that the general public has the skills to use such technologies.

Shaping the mentality

The needs for education, skills and information should be viewed as needs required to achieve orientation in the environment, see the whole picture, identify the model of behavior and methods to handle challenges, achieve internal balance and adjust to the social environment. If unmet, these needs will make intelligent and rational human behavior impossible. Picturing the environment and identifying models and stereotypes of human attitude to a process precede the formation of a common mentality.

Risks to human life are determined by economic and social development

Mentality and attitudes should be shaped in relation to national technological development as part of work on the receptiveness of society, extensive involvement and recognition of the need for this process.

Collective and individual mentality embrace sustainable spiritual values, deep axiological directives, skills, reflexes, latent habits and long-term stereotypes studied within certain special and time boundaries and underlying behavior, lifestyles and the perception of certain phenomena. In other words, mentality is an integral characteristic of people living in a certain culture that allows them to describe the original vision of the world and explain people's reactions to it.

One of the components of mentality is social response. This is a response by a collective or individual to a policy, action, etc. undertaken by government. Although innovative activity does not require the involvement of the entire population, it is impossible without public support. The experience of many countries shows that underestimation of the importance of mentality and public attitude to national policies may be destructive.

Henri Bergson, a French philosopher, wrote: "History shows that technological development of a society does not ensure moral and ethical development of people living in it. Better material commodities may even be harmful if not accompanied by respective spiritual efforts". According to this statement, the notion of mentality should accompany societal recognition of the inevitability of technological progress for social benefit as well as recognition of the need for an informed approached to the introduction and use of technologies and comprehensive analysis of the implications and risks.

3.4. International practice of introducing new technologies in the context of globalization

Let us look at some international practices that demonstrate solutions to the issues examined in the previous sections. The development of national science has become a major factor impacting countries' social and economic development and their niche in the global economy. Studies shows that it is the level of scientific development and correlated technological innovation that have become the foundation of present-day welfare and good living standards in developed countries. Therefore, studying national science and technology systems and their levels of development is an important topic of research.

Risks to human life are determined by economic and social development. Statistics show that the higher the level of socio-economic development and, as a result, the better the system of socio-economic safety ensuring protection from harmful environmental effects, the higher the life expectancy.

Today, the development of high-tech industries that use science-intensive technologies determines the overall situation on the global market of

Box 3.4.1

Science in the US

The American R&D system is traditionally multi-level, relatively decentralized and multi-sector. Official American statistics distinguish between five main sectors engaged in R&D:

1) the Federal Government owns or oversees research institutions, centers and national laboratories;

2) academic research centers funded by Federal Government but accounting to private bodies;

3) universities and colleges;

4) industry (research centers and divisions of American corporations and companies);

5) so-called "non-profit" organization and institutions.

In the early 21st century US expenditure on R&D in absolute terms reached a record-breaking level of USD312.068 billion (at 2003 prices) reaching 2.66% of GDP.

In 2004 the Federal budget funded 29.9% of all national R&D. However, the major source of R&D funding was the internal budgets of American corporations and companies, which accounted for 63.8% of all R&D expenditure. Thus, the two major sources of R&D funding were Federal Government and industries. These two combined accounted for 93.7% of overall US expenditure on R&D, while internal R&D budgets of American universities and colleges accounted for 3.6%.

An important characteristic of US industrial R&D is that it is based on self-funding. Industries deliver 63.8% of the national R&D budget. However, only 4.8% of the industrial R&D budget is spent on fundamental research. At least 90% of all industrial R&D is short-term applied research to improve products.

The most important and enduring characteristics of academic R&D in the US are the relatively stable list of leading American universities and colleges engaged in R&D and the relatively high concentration of financial resources, including Federal Government money, distributed within the US academic system. Thus, in 2001 96% of the academic R&D budget was delivered by 200 leading American universities and colleges that accounted for 6% of all academic centers in the US (around 3,600 institutions), while 80% of the academic R&D budget was delivered by the first 100 academic centers, 17% by the first 10, and 14% by the second 10.

technologies and national niches in the global economy. The annual volume of the global market of science-intensive products totals approximately USD2.5-3 trillion, which is more than the market for energy and raw materials. Modern development of the global economy displays a steady trend of accelerating growth of processing industries producing science-intensive products. In such countries as the USA and Japan, science and technology account for a 65-80% increase in national revenues.

The total value of global technologies is estimated at around 60% of overall Gross Global Product, while the growth rate for sales of technologies exceeds that of other goods. Thus, in the 1990s the total value of global sales of technologies was estimated at between 20 and 50 billion US dollars, but had risen to USD500 billion by 2000. Sales of technologies are very profitable, with operational costs only accounting for 10-25%.

New technologies and high-tech goods and services are, as a rule, a result of systematic investment in R&D, which is the case in almost all high-income OECD countries and a few Asian and Latin American countries. OECD countries, home to 14% of the global population, account for 86% of patent applications registered globally. The OECD countries allocate more to R&D both in absolute and percentage terms – an average of 2.4% of GDP, compared to 0.29% of GDP in Kazakhstan.

Countries striving to be leaders in science apply a scheme by which government-funded R&D findings are transferred to a local producer free of charge or for a token amount, in exchange for an obligation to invest in production or create a certain number of new jobs. In these countries there is no center to regulate innovation, while coordination mechanisms are in place, as well as a legal framework stimulating more resources from the private and business sectors and reduced government funding. This is a "leading" innovation policy or "growth" policy by which innovation is based on domestic fundamental and applied research in almost all leading areas of high technology.

Globally, there are two main approaches to funding science:

1. Direct government involvement in knowledge creation through organization of large laboratories funded from the national budget and distributing findings free of charge to a wide range of potential users. Typically, such laboratories are responsible for research in health, defence, energy and agriculture.

2. Grant programs for fundamental research open to scientists working outside national laboratories. Grant conditions include full accountability and reporting and public disclosure of findings.

In such countries as the USA and Japan, science and technology account for a 65-80 % increase in national revenues

Box 3.4.2

Science in Finland

The national structure of scientific and innovative development is based on the Ministry of Education (MoE) and Ministry of Trade and Industry (MoTI) who implement the national policy in science and innovation, coordinate all parties involved and oversee leading national R&D organizations. In 2006, R&D expenditure totaled: Tekec (MoTI) – National Technological Agency – 478.2 million Euros; 20 universities and 30 higher education establishments (MoE) – 427.5 million Euros; research institutes (MoTI) – 272.6 million Euros; the Academy of Finland (MoE) – 257.4 million Euros.

The Science and Technology Policy Council under the Finnish Government headed by the Prime Minister is responsible for national policy for research and technological development. The ministers of education, trade and industry are deputies to the Council's head. The Council includes ministers of finance, foreign trade, defence and culture, the director general of the National Technological Agency (TEKEC) and the Finnish Center for Technological Research, heads of the Finnish Academy, trade unions and universities of Helsinki, Turku and Jyvaskyla, as well as Nokia and Premix companies.

Once every 3 years the Council develops a national innovative development program defining priority areas of science and technology. The program is implemented by government organizations under the different ministries. In 2006 the Ministry of Education, responsible for fundamental research, humanitarian research and education delivered 42.6% of the total R&D budget, or 715.4 million Euros. The Ministry of Trade and Industry, responsible for applied research and high technologies, delivered 34.9%, or 586.9 million Euros, while the Ministry of Health delivered 7.5% or 125.6 million Euros, the Ministry of Agriculture and Forestry – 5.9% or 99.3 million Euros and other ministries 9.1%.

The main funding sources for science are the private sector (69.8%) and the government (30.2%). Expenditure on science, research and technology accounted for 4.4% of the national budget in 2006 or 1.680 billion Euros. 0.99% of GDP, which is what the Finnish government spends on R&D, is one of the highest indicators in Europe (average 0.77%). Finnish R&D employs over 70,000 specialists. Annually, 1,200 doctorate degrees are awarded, of which 45% are women.

In Western Europe expenditure on fundamental research is higher than in the USA and Japan. Western European countries recognize the importance of fundamental research as a source of new scientific knowledge.

Government-funded R&D findings are transferred to a local producer free of charge or for a token amount, in exchange for an obligation to invest in production or create a certain number of new jobs

Under the first scheme, government funds between 20 and 50% of R&D costs. Government funding covers the R&D cost of fundamental science in universities, defence-related research in national laboratories and contracts with the private sector.

According to global practice, the following tax benefits are used to promote science and innovation:

- including of the costs of innovative processes in the net cost of products;
- research and investment tax credit, i.e. deferring tax payment on revenues for innovative purposes;
- tax 'holidays' of several years for revenue from innovative projects;
- targeted tax benefits aimed at a continuous increase in R&D expenditure by different organizations;
- reduced taxation on dividends accrued from shares in innovative enterprises;
- reduced taxation of revenues in the amount of the costs of devices and equipment transferred to higher education establishments, research and other organizations;
- deduction from taxable income of contributions to charitable organizations funding innovation.

Compared to the above schemes, Kazakhstan uses the following tax privileges:

– property tax reduced by 10 times for scientific organizations versus profit-making entities;

– exemption from VAT on research funded by government;

– exemption from income tax for government-run scientific organizations.

In our opinion, such tax privileges only apply to government-funded research and research conducted by government-run organizations. This is therefore insufficient to attract business and private sectors and foreign investment to science and technology in Kazakhstan. Government support is much needed through financial, tax and legal mechanisms required to develop science and technology intensive products and services in Kazakhstan.

Compared to the above schemes, Kazakhstan uses the following tax privileges:

Table 3.3.5. Tax incentives in R&D and innovative activity in other countries [41]

Australia	Deduction of 125% of R&D costs. 175% deduction from total R&D costs exceeding previous year costs of basic fixed amount. Deductions of 125% are equivalent to direct 7.5% tax credit for R&D. 50% of all R&D companies are foreign.
China	Deduction of 150% of R&D costs for foreign investors in the event of 10% increase in R&D costs versus previous year. This privilege targets increased start-up operations.
India	Deduction of R&D costs of 100% of taxable basis of revenue for 10 years.
Japan	Direct 10% tax credit for R&D and 15% credit for small businesses.
Korea	Tax holidays for up to 7 years for high-tech industry. Different deductions for R&D.
Singapore	Tax holidays for foreign revenues from Singapore R&D.
United Kingdom	125% deduction from R&D costs and 175% deduction from total R&D costs exceeding previous year costs of basic fixed amount.
France	50% tax credit for R&D consisting of 5% direct loan and 45% credit for R&D costs.
Canada	Constant 20% direct loan for R&D. Different tax mechanisms for provincial development.
USA	100% deduction of R&D costs and 35% tax credit for R&D.

– property tax reduced by 10 times for scientific organizations versus profit-making entities;

– exemption from VAT on research funded by government;

– exemption from income tax for government-run scientific organizations.

In our opinion, such tax privileges only apply to government-funded research and research conducted by government-run organizations. This is therefore insufficient to attract business and private sectors and foreign investment to science and technology in Kazakhstan. Government support is much needed through financial, tax and legal mechanisms required to develop science and technology intensive products and services in Kazakhstan.

A review of international practice in innovative development, regulation of innovative processes and models of innovation policies leads to the following conclusions.

Firstly, international practice offers a wide range of economic instruments of science, technology and innovation policies that can be used to regulate innovative processes at the micro and macro levels. Such instruments are costly, and even the rich countries cannot afford them.

The appropriateness of government 'interference' in the private sector of a market economy is debatable. Nevertheless, as experience of developed countries shows, effective government support to innovative business can be positive for the national economy. In developed countries science and innovation policy pursues the goals of increased contribution of science and technology to economic development, better global competitiveness of national products, improved national security and defense capacity and an improved environmental situation.

Current tax privileges are insufficient to attract business and private sectors and foreign investment to science and technology

Secondly, without interfering in the private and business sectors, the government can create an enabling economic and socio-political climate for innovation through direct and indirect influence. Such an economic and socio-political climate includes innovative relations between government and innovative entities of different ownership type.

Thirdly, small and medium innovative business is a sphere for government support. Hindrances to the development of small innovative business include risk, lack of financial resources, competition with large corporations, inflexible tax and amortization policies. Government supports small innovative businesses through the legal and legislative framework, privileged credit, reduced taxation, direct budget funding, information, advice, marketing and human resources. Business incubators and technology parks are an effective form of support for innovation.

Fourthly, present-day innovative development trends in developed countries show that innovative development is well supported in a framework of national innovative systems, with a combination of interlinked institutions and mechanisms focusing on the production and commercial use of scientific knowledge and technology within national borders.

Experience of developed countries shows that the rate of social and economic development depends on:

- the effectiveness of research based on national interests and having both practical and human development values;
- the effectiveness of a system of obtaining, processing and transferring science and technology information to economy and science;
- a range of innovative establishments with the capacity to implement the achievements of national and international science;
- a legal and legislative framework enabling economic entities speed up the production of new goods and services.

***

The major conclusions of this chapter are as follows:

1. Technologies play a significant role in improving the quality of human life and living standards. By using its scientific and technological base, Kazakhstan can improve its capacity in technology. Substantial government support is required through effective legal, regulatory and fiscal mechanisms to facilitate innovative activity and the production of science-intensive and high-tech products and services that will eventually contribute to improved national welfare.

2. Recognition of technological and social innovation at the levels of government, business and private communities is important for socio-economic development. Information on the development and implementation of national scientific and technology programs should be made public and supported by the public sector.

3. Developing human resources. Young scientists and researchers should be more mobile, while creative work and technological innovation should be stimulated for the benefit of human capital.

4. Bridging the innovation divide. Access to education and technological commodities should be ensured for different groups of the population, while the digital divide between rich and poor, young and old, men and women should be bridged. Inequalities and disparities should be borne in mind when developing and implementing science and technology policies, which should be the foundation for great achievements in science and technology. This requires multi-goal strategies based on justice and equal rights.

5. The quality of research should be improved through provision of good equipment, access to information, material rewards and attracting highly-qualified specialists and experts to Kazakhstan.

6. Action should be taken to promote demand for scientific and technological products and services produced by local scientific and research organizations. It is important to ensure a market-based approach to stimulate domestic demand for domestic scientific products and technologies.

7. Best practice should be adapted and used in Kazakhstan alongside transfer of new knowledge and technologies. The innovation policy implications and implementation mechanisms used in the most competitive countries should be carefully reviewed - in particular, their fiscal, tax, regulatory and legal instruments.

CHAPTER 4. PROMOTING AN ENABLING ENVIRONMENT FOR NEW TECHNOLOGIES IN KAZAKHSTAN

This chapter attempts to outline the main concepts, conditions and mechanisms required to develop an environment conducive to new technologies in Ka-zakhstan, look at the importance of innovative infrastructure and legislative protection of intellectual property and provide a brief overview of the tech-nological development implications of Kazakhstan's WTO accession.

4.1. Fundamentals of an innovation system

An innovation system is a combination of economic entities interacting together in the process of development and introduction of innovative products and services and engaged in innovation within the relevant legal framework based on national policy. An effective national innovation system in Kazakhstan should promote new ideas and knowledge and transform them into ready-made products and services that are demanded directly by Kazakhstan's consumers and society. In other words, as a dynamic system the national innovation system should operate in an environment enabling development and transformation of knowledge into a material product when the outcomes of the innovation process are new technologies. Kazakhstan has an ambitious target of making management, financial and organizational decisions to set up basic structures for innovation, which requires continuous overview and detailed attention. What fuels this ambition is that developed countries keep developing dynamically and setting up comprehensive knowledge-based innovation systems.

This section describes the first attempts to create the fundamentals of a national innovation system as set forth in the Program for Development of a National Innovation System for the Republic of Kazakhstan for 2005-2015. Also, the section discusses some concepts that are important in setting up the basic structures required for innovative development.

Innovation is viewed as a product of a non-linear continuous process, i.e. innovation is not a direct end product of scientific or technological discovery. In addition to R&D, the non-linear process includes such measures as training, design, financial marketing, etc., while effective combination of such measures promotes innovation. Moreover, innovation is also seen as communication between enterprises (economic agents) and the external environment. Enterprises alone cannot create innovation, but through cooperation with scientific institutions, technological centers, consulting companies and even competitors. A holistic approach should be taken when looking at this process, since any communication is based on the capacity of all the parties involved.

In order to expedite the innovation processes, the national government works to set up and strengthen constituent sub-systems and infrastructure of the national innovation system (Box 4.1.1). This includes establishment of scientific centers, financial institutions, technology parks and incubators at the regional level, revision of the

Box 4.1.1

According to the Program for Development of a National Innovation System for the Republic of Kazakhstan for 2005-2015 *the national innovation system is divided into the following major subsystems, each of which includes such elements as:*

1. Scientific capacity is an important factor influencing innovative development. It is formed through the development of applied research that brings fundamental development into commercial use. Scientific capacity includes:

a) government-run scientific organizations such as national scientific centers, research institutions, higher education establishments, design institutions;

b) scientific organizations under national companies and laboratories under large enterprises;

c) private research and design institutions;

d) small and medium-sized enterprises engaged in research;

e) scientific cadre and individual inventors;

f) material and technological resources.

2. Innovative business is a link between science and technology and production, while the ultimate purpose is to develop enterprises capable of efficiently responding to current market conditions and setting up production of competitive, high-demand, new generation science-intensive products complying with international standards. Innovative business includes:

a) business angels;

b) enterprises;

c) innovative managers.

3. Multi-level innovative infrastructure is a system of interlinked production, consulting, educational and information structures supporting innovation. Innovative infrastructure consists of the following elements:

a) national technology parks;

b) regional technology parks;

c) technological business incubators, etc.

4. Financial infrastructure is a key link for complex funding of science, production and educational processes related to innovative and technological development. It is based on a combination of different mechanisms of direct and indirect government support to innovative business and infrastructure. Financial infrastructure includes:

a) government-run development institutions;

b) venture funds;

c) enterprises;

d) individual entrepreneurs;

e) second-tier banks, etc.

An effective national innovation system in Kazakhstan should promote new ideas and knowledge and transform them into ready-made products and services

MoES should undertake institutional reforms for better coordination of science and technology processes

legislative framework in the area of patents and intellectual property, identification of priorities for the development of an institutional basis for science and technology.

To assess the effectiveness of such measures each constituent component (sub-system) of the national innovation system should be reviewed.

Science and research

In 2003, after Kazakhstan's National Academy of Science lost the status of a government-run agency, scientific institutions and schools overseen by the Academy of Science were placed under the authority of the Ministry of Education and Science (MoES). This means that the MoES is in charge of many scientific, research and production institutions, while this organizational system can be viewed as an active knowledge structure within the national innovation system. Considering the fact that this system cannot be the only element to create and distribute relevant knowledge, firstly, for the national economy, the MoES should undertake institutional reforms and coordinate them with other key national ministries. The ministry should systematically review the capacity to promote science and research in order to improve the quality and relevancy of R&D.

Kazakhstan should pay special attention to the development of qualified scientific and engineering cadres

Recently, the MoES has opened national centers for biotechnology, land studies and astrophysical research, which bring together a number of scientific organizations and establishments. Such centers will accumulate essential resources required to work on priorities in science such as staffing, technology, equipment, experience and knowledge.

Agencies under the MoES work to enhance principles of scientific and technological assessment of R&D funded out of the national budget and improve the quality and relevance of planned and current R&D. Projects are underway to improve science and information through the creation of a science web-site and e-access to databases of scientific and technological institutions and libraries. In order to strengthen the material and technological base the MoES is considering the possibility of setting up a system of national science laboratories and technology centers based within leading scientific institutions and universities. This should contribute to the development of R&D and science and technology priorities. Laboratories will run according to new standards of R&D quality management, which are called good scientific practice and good laboratory practice.

The targets and measures described above require careful research and understanding of the real needs of the scientific community and the business and public sectors. In order to increase the efficiency of science and technology, related projects based on priorities the Ministry of Education and Science should closely cooperate with key sectoral ministries, in particular the Ministry of Industry and Trade through funding and implementation of joint medium-term projects.

Human resources are a determining factor for the development of science and research. Kazakhstan should pay special attention to the development of qualified scientific and engineering cadres. With current manpower policy the science and research system is likely to face a lack of qualified staff, as mentioned in Chapter 3, due to an insufficient inflow of talented young scientists and researchers to science and technology. The scale of science and research is largely dependent on adequate human resources. With an increase in government expenditure on R&D in the future (by 25 times by 2015), the government's ambitious plans may lead to fast-growing demand for scientific and engineering personnel. Considering the highly elastic research labor supply, increased expenditure on science will result in increased remuneration of scientists and engineers, until market balance is restored through additional supply of new researchers and scientists. This will promote competition on the scientific labor market, thus improving the quality of R&D for national economic and social development. However, the problem is that it may take until the medium-term attract and train talented young researchers and engineers, which means that a well-considered approach should be taken to ensure a steady and regular increase in expenditure on science (see Annex 2, Tables 19, 20).

Many countries such as Sweden, Finland and Ireland have succeeded in increasing the efficiency of their national innovation systems through a regular increase in the corps of scientific and engineering personnel (candidates and doctors of science) and creation of an enabling research environment for scientists and engineers that retains them in this sphere and promotes science and research.

Innovative business

As discussed in the previous chapter, innovative business plays a key role in promoting the introduction and use of new technologies in the production sector and improving the employment rate. Currently, Kazakhstan has an unbalanced innovation system, in particular, between science and technological development and transfer of technologies. This is because the outcomes of R&D fail to meet the needs of the supporting system, national security and the growing demand for innovation on the part of a number of segments of the business and social sectors.

Given that the bulk of research is applied research, accounting for 76.5% of all national R&D, attempts have been made to transform the selected outcomes of applied research to development. The initiators of these attempts, however, faced the lack of interest on the part of industrial enterprises to be involved in the process. The reason is that enterprises prefer to specialize in active industries, due to limited technological capacity and awareness. This is explained by a phenomenon, which Martin Fransman[42] defined as *"bounded vision"*: *"…vision of corporate profit sources is based, primarily, on active (raw material) markets, production and R&D and respective short and mid term needs for satisfactory profit. The reason behind bounded vision is that it takes some time for new technologies employed in neighboring spheres and not related to the operations of such enterprises to get into corporate vision…"*

Thus, the need to gain satisfactory profit in the short and medium terms limits the vision of enterprises and makes for only short-term forecasts. Consequently, due to great commercial uncertainty enterprises sometimes refrain from funding projects related to new technologies. Furthermore, research involves risk and large initial investment. In order to invest in such projects, enterprises should be able to set prices for planned new products higher than the total costs incurred through production. However, this is difficult to do because of uncertainty about the investment outcome, rather than lack of information about costs to be incurred. For example, the development of a new original medication made of locally grown plants may take between 3 and 20 years and require extensive financial resources, from synthesis of a new compound to mass production. There are no investors who could invest in such expensive and long-payback projects.

On the other hand, generation of new knowledge from R&D to be used for the development of a new product may be dependent on past activities related to the generation of such knowledge. Knowledge may be codified or undisclosed, which will be a barrier to its access and transfer. Distribution of funding shares and property rights on R&D products may be key. The government can play an important role in engaging the private and business sectors in risky projects by providing initial funding.

Development of new technologies is an uncertain, complex and multi-dimensional process. The initial obstacle enterprises face is to identify internal technological capacity through market research. This will help identify a niche in which to create and use new technologies.

However, such action can also be taken based on existing technological skills and knowledge. Enterprises will only undertake research to define new technological solutions if there is a problem that cannot be solved using existing knowledge of the enterprise. In other words, in Kazakhstan R&D is not necessarily primary to generate new ideas and technologies. Rather, R&D should be viewed as activities aimed at identifying solutions in the context of innovation.

Innovative infrastructure

Innovative infrastructure is the necessary organizational and institutional basis determining the role of each participant of the innovation process. According to the Program for Development of National Innovation systems, one part of innovative infrastructure is technology parks and incubators, although these might be better identified as technological infrastructure. Technology parks and incubators are required to facilitate transformation of knowledge and technologies into new products and services that will occupy new market niches. In Kazakhstan, existing technology parks and incubators look for new investment projects to be funded through different sources such as investment and innovation funds, second-tier banks and the business and private sectors. However, technology parks should also use and concentrate

Innovative business plays a key role in promoting the introduction and use of new technologies in the production sector and improving the employment rate

Due to great commercial uncertainty enterprises tends to refrain from funding projects related to new technologies

[42] *Martin Fransman, Phenomenon «Bounded Vision»(1990:3).*

Technology parks should also use and concentrate such intensive factors as knowledge-intensive and high-tech resources that can be obtained from different sources such as scientific institutions, universities, industrial associations and enterprises and marketing centers

such intensive factors as knowledge-intensive and high-tech resources that can be obtained from different sources such as scientific insti-tutions, universities, industrial associations and enterprises and marketing centers. Such resources will help to generate knowledge, which can then be used in practice.

Scientist Kenneth Arrow (1962) upposed that a technology can be viewed as a form of knowledge and the know-how of material transformation[43]. Nevertheless, it is very difficult to evaluate the economic cost of knowledge without its transformation into new technologies and products. This is where technology parks should come in and handle, first of all, commercialization of knowledge and transfer of technology. Incubators, in turn, are entities that provide services to manage the factors of production cost-effectively, i.e. knowledge-intensive services that allow reduced production costs. Technology parks and incubators are an undeveloped link in the basic innovation infrastructure, since what is required is the recognition of the changed relation between economic agents and a new structure within the innovation process.

Kazakhstan's financial institutions should consider the development of a number of interlinked activities and programs to support innovative enterprises that work to develop new products and services based on local R&D

Financial infrastructure

Over the last decade, Kazakhstan has set up such financial institutions as the Investment Fund, the Kazakhstan Development Bank, the Fund for SME Development and the National Innovation Fund. Such financial institutions and mi-nistries are the main agencies executing national innovation policy. Major purpose of financial infrastructure is to provide financial services to active and new enterprises, expert services for project management, coordination and administration of projects to be funded. Keeping in mind the importance of global integration, such institutions actively encourage investment projects aimed at the import of new technologies to Kazakhstan.

It is noteworthy that technologies that the world has been using for a long time are imported to Kazakhstan as new or advanced technologies. This helps to modernize the technological base of national industries, while the investment and legislative framework provides enabling customs and tax mechanisms. However, in order to speed up innovation processes, Kazakhstan's financial institutions should consider the development of a number of interlinked activities and programs to support innovative enterprises that work to develop new products and services based on local R&D. It is apparent that the commercial success of such innovative projects can be limited due to high technological risks. However, the public policy of financial institutions funded through the government should focus on financial and expert support to innovative seed and start-up projects, for example, in the form of funding of R&D through grants and loans. Such financial institutions should take on the risk of non-payback of initial investment, which the private or business sector cannot afford or is not interested in doing.

Of the above institutions, the only active financial participant of innovative projects is the National Innovation Fund, holding approximately 5% of the overall portfolio to fund applied industrial research and development through grants and soft loans.. However, there is currently no registration of the Fund's involvement in such projects or it may only be starting.

Therefore, the role of the above-mentioned financial institutions is of material importance to activate innovative processes in Kazakhstan, since such financial services and mechanisms help remove gaps in the innovative process and improve the efficiency of the innovation system.

Based on the above, it is necessary to look at infrastructural support to innovation. Attention should be paid to important services that promote communication and cooperation within the innovative process as a whole and define the roles and functions of the players in the process of development of new technologies. Such functions may include financial support, information, marketing and consulting services, training, assistance with reaching markets through trade centers, etc.

International experience of the development of national innovation systems indicates three main stages of development:

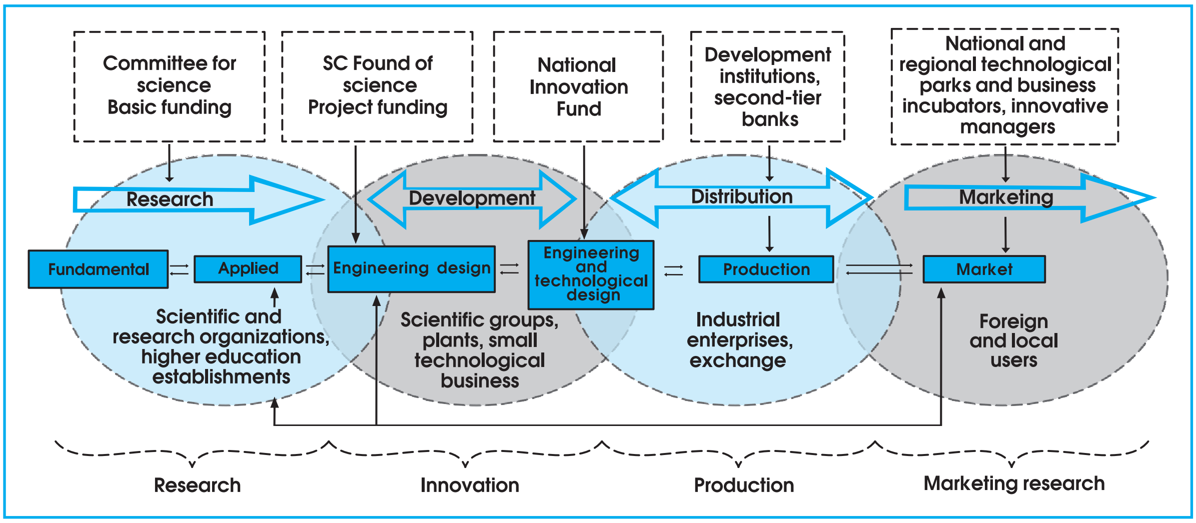
1) setting up the basic structure defining the main political principles and concepts of science and technology policy and establishing certain institutions for science and technology.

2) technological orientation, i.e. development and implementation of technological policy pursuing certain goals, and development of mechanisms to transfer, distribute and commercialize technologies.

3) creation and development of a society and national innovation system based on knowledge and the following four principles: generating and em-ploying knowledge and know-how; important R&D and education systems;

[43] *Evaluation of the Finnish Innovation Support System, Ministry of Industry and Trade, Finland. Edition 5/2003.*

Figure 4.1.1. Innovation system development model



Source: RK National Center for Scientific and Technical Information, 2006.

ensuring an environment to enable the development of new technologies and cooperation at the national and international levels.

Thus, the development model for innovative processes can be graphically pictured as follows (Figure 4.1.1).

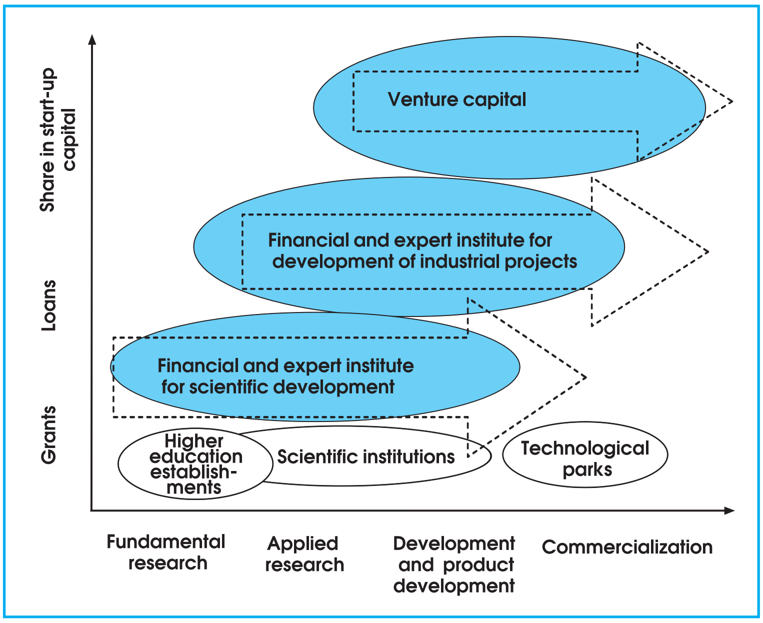
This model shows the linear linkage between participants of the innovation process, which conflicts with the existing practice of development of a system or a systematic approach to innovation. The linear model can be used if the real needs of customers are identified, production planning is flawless and (raw materials) markets non-elastic. Due to inconsistency between the linear model and reality, an alternative approach to the innovative process was taken (Figure 4.1.2).

What distinguishes this model is that services provided throughout the innovation process are needed at the same time rather than one after another, i.e. the process is not only interactive but also an integrated and continuous interaction of different components of the innovation system. In other words, fundamental and applied research involves elements required in the process of development and/or commercialization of products. For example, the development of new materials can simultaneously involve interdisciplinary scientists and researchers, as well as engineers and specialists of industrial corporations working in allied spheres. This approach sees knowledge generation and transfer of technology as a whole system, rather than part-by-part, as was the case in the linear model of linkages between different subsystems. In addition, this approach allows consideration of parallel or simultaneous operation of the three development stages of the innovation system, since the development of new technologies includes continuous review and interaction of different innovation system stakeholders.

Thus, in order to activate innovative processes, coordination is needed to support different areas of technological progress. Such actions should be pro-active and respond to innovative opportunities that can be long-term, unexpected or destructive. Obviously, such actions will have unpredictable outcomes. Therefore, the innovation system needs some processes to identify, adjust and develop new technologies. This includes foresight monitoring, assessment of the systems and subsystems, as well as scientific and research

In order to activate innovative processes, coordination is needed to support different areas of technological progress

Figure 4.1.2. Support to innovation process



Source: www.research.fi

programs that prepare the innovation system for long-term changes. In other words, there is a great need to combine foresight and strategic measures, including foresight, economic analysis, monitoring, coordination and long-term science and technology programs. This means that there should be an active "change agent" in the national innovation system, while the existing components of the innovation system should be brought together and implemented as pro-active measures for the benefit of human security.

4.2. Legal framework for innovative development

There are still some legal gaps that directly or indirectly affect innovative development

In addition to the above, the current development context in Kazakhstan requires an adequate approach to the development and revision of the legal framework for science, technology and innovation and special programs for these processes. There are still some legal gaps that directly or indirectly affect these processes. A review shows that the existing legal framework pertaining to different aspects of innovative activity, including forms of small business organization, lacks integrity and should be improved. Not only should new laws be adopted but some incomplete documents should be completed, existing instruments amended and conflicting provisions removed. To this end, the following issues should be addressed:

1) outstanding issues related to business development, including small enterprises engaged in science and technology. Although the new Law "On private business" has legislatively identified national priorities to support business, at the sub-legislative and administrative levels major barriers remain, including licensing, inspection, limited access to information, nontransparent government procurement, certification, sanitary standards and other measures of government regulation;

2) weak anti-monopoly laws. As a result, the overall system of anti-monopoly regulation is not conducive to comprehensive development of competition on the domestic market. In practice, this trend has been emerging in large holdings, with abuse of dominant market positions and poor development of outsourcing;

3) innovation should not be promoted at the cost of the environment or conflict with environmental laws. In Kazakhstan, normative documents tend to focus on parties when regulating social relations (payment for environmental use and pollution). In relation to reconstructed enterprises using environmentally friendly technology, a more flexible fining scheme should be applied in case of environmental pollution. On the other hand, fines for over-quota emissions are much less than the resources required to re-equip production and, therefore, fail to stimulate a reduced level of environmental pollution. Some changes in the underlying principles of the environmental legislation would facilitate the introduction of new technologies in production;

4) various gaps in patent laws and practices. The most notable gaps are lack of legislative incentives for creative labor and real mechanisms of brain drain control, etc. Currently, this very developing and specific area of legislation is being formed under pressure and involves the clash of many departmental interests. This report did not attempt to look at this sphere of legislation in detail so we can only emphasize the importance of a specialist review and recommendations for improvement;

5) ineffective system of technical regulation. Currently, there are over 70,000 mandatory technical norms and standards, including normative acts written during Soviet times. This creates more barriers to the introduction of new technologies by the business sector. The new Law "On technical regulation" seeks to change this situation. At the same time, the transition to a new two-level system of technical regulation and development of sub-legislation are being delayed as some sectoral government agencies do not understand and counteract the introduction of the policy;

6) despite the efforts made, it seems difficult to take an adequate approach to depreciation policy. As a result, businesses do not have incentives to upgrade key assets and introduce new means of production;

7) laws on venture funds should be developed, as well as on trade secrets, secret inventions, transfer of technology of double purpose, intellectual products funded through the national budget, government procurement of innovation development services, etc.

In conclusion, the authors note that the legal framework governing technology and innovation is in line with the development rate of this sphere as set out in major policy papers and facilitates public involvement in the innovative process. This should, it is hoped, have a positive effect on the socioeconomic development performance of Kazakhstan. Given that the legal framework is relatively recent, its efficiency will depend on the implementation of norms and provisions, cooperation between different government agencies and ade-quate response to global changes. There remain some legislative gaps indirectly affecting technological development and requiring systemic solutions.

Intellectual property

In the context of globalization, intellectual property is a powerful tool for economic development and can be equally employed by developed and developing countries, transnational companies and small enterprises. As an outcome of any scientific activity, intellectual property can be an economic category in the form of only patent rights that can be used as a manageable capacity of industrial property for the emerging innovative economy.

Intellectual property becomes even more important when all aspects related to its commercialization are considered. The international system of protection of intellectual property allows market entities to make their produce more competitive.

In relation to the protection of intellectual property rights, the Strategy for Industrial and Innovative Development of Kazakhstan aims to: 1) bring the legal protection of intellectual property rights up to international standards; 2) develop mechanisms to ensure practical application of the legal regime to protect intellectual property rights; 3) train highly qualified specialists in the protection of intellectual property rights.

Presently, Kazakhstan is a signatory to major pacts, agreements and conventions concerning the protection of intellectual property with national legislation made fully compliant with international standards and practices.

Until recently, many people in Kazakhstan treated intellectual property as a vague legal concept without much practical significance for everyday life. Today, however, businesses and enterprises are coming to understand that the exclusive right to intellectual property is a special type of competitive advantage.

There are a growing number of applications from citizens who wish to register their copyright and concluded license agreements between market entities.

Thus, the Committee for Intellectual Property Rights under the RK Ministry of Justice reports that over the first 6 months of 2006 some 232 author's works were

registered, which is 40% more than in 2005. Also, 744 licensing agreements between users and rights holders were officially registered, which is 3 times more than the same period in 2005 (214).

At Kazakhstan's current stage of development, protection of intellectual property is a key priority. The need for a modern system of intellectual property protection is becoming ever more obvious in light of Kazakhstan's WTO accession, which requires bringing national legislation into line with the Agreement on Trade-Related Aspects of Intellectual Property Rights.

As part of Kazakhstan's accession to WTO, the National Plan of Action for 2004-2006 was adopted to harmonize national laws related to intellectual property rights and the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement).

As a result of WTO accession negotiations, Kazakhstan committed to implement the TRIPS Agreement without a transitional period and to continue improving law enforcement practices.

At the same time, Kazakhstan's intellectual property legislation fails to affect science and technology due to the lack of provisions stimulating broad-based and rapid use of intellectual property and regulating competitive relations.

Improved intellectual property laws should be based on the following principles:

The efficiency of legal framework governing new technologies and innovation will depend on the implementation of norms and provisions, cooperation between different government agencies and adequate response to global changes

The international system of protection of intellectual property allows market entities to make their produce more competitive

Box 4.2.1

International agreements

Kazakhstan is an equal party in a number of major pacts, agreements and conventions, including the Convention founding the World Intellectual Property Organization (WIPO), the Paris Convention for the Protection of Industrial Property, the Madrid Agreement Concerning the International Registration of Marks, the Patent Cooperation Treaty (PCT), the Berne Convention for the Protection of Literary and Artistic Works, the Nice Agreement concerning the International Classification of Goods and Services for the purpose of the Registration of Trademarks, the Strasbourg Agreement concerning the International Patent Classification, the Budapest Treaty on the International Recognition of the Deposit of Microorganisms for the Purposes of Patent Procedure, the Global Copyright Convention, the Locarno Agreement for International Classification of Industrial Designs, the Trademark Law Treaty, the Eurasian Patent Convention and the Convention for the Protection of Producers of Phonograms against Unauthorized Duplication of their Phonograms.

Kazakhstan has concluded bilateral agreements on intellectual property cooperation with Azerbaijan, Kyrgyzstan, Georgia, the USA, Russia and Uzbekistan. According to the cooperation agreement with the Russian Federation, Russian applicants will be granted a national legal regime in relation to protection documents and payment of fees and dues.

Kazakhstan's active legislation ensuring protection of intellectual property rights consists of the Civil Code (general provisions) of 27 December 1994, the Civil Code (special provisions) of 1 July 1999, the Criminal Code, the Administrative Code, the Laws "On copyright and related rights" of 10 June 1996, "On trade marks, service marks and origin marks" of 26 July 1999, the Patent Law of 16 July 1999, "On protection of selected achievements" of 13 July 1999, the Customs Code of 5 April 2003 and "On legal protection of layouts of integral microchips" of 29 June 2001.

Today, Kazakhstan has almost finished harmonizing national intellectual property rights legislation with the TRIPS Agreements.

Kazakhstan's intellectual property legislation fails to duly affect science and technology

- wider use of legal norms permitting direct application;
- government regulation of the use of intellectual property funded from the national budget for the benefit of society;
- reducing unfair competition in relation to investors;
- economic incentives for the use of intellectual property on a licensed basis.

Considering the above principles for the creation and protection of intellectual property, it is recommended to:

- coordinate research on the economy of intellectual property, including review of books, scientific articles and dissertations, and establish contact with international research centers working in the same field;
- review the current national intellectual property policy and prepare recommendations on the most pressing economic issues concerning inventory, assessment and use of intellectual property;
- prepare subject glossaries and evidence-based recommendations for more accurate vocabulary to be used in normative documents related to the assessment, inventory and use of intellectual property and intangible assets;
- assess training courses, standards and methodology notes on the assessment of intellectual property and intangible assets;
- promote public access to information and prevent over-commercialization of access to information on industrial property;
- facilitate an increase in the corps of patent engineers and patent attorneys through attestation in a legislatively specified order;
- ministries and departments funding science and research should budget costs of registration of rights to intellectual property funded from the national budget, as well as costs of legal action, including that to keep protection documents valid and pay the author's fee.

In order to improve taxation of action to ensure legal protection of intellectual property, it is worth considering exemption for enterprises engaged in patent and license operations in relation to industrial property from value-added tax and from intangible asset property tax for 3-5 years.

Ministries and departments should provide patent and legal support to scientific and technological projects funded by foreign and international organizations and tighten supervision of imports and exports of technologies to serve national economic interests and security.

The use of protected industrial property should be promoted through reduced taxation schemes, which should be applied to income from such use in internal production and income from the sale of the operating license.

To effectively handle disputes about violation of the exclusive rights of patent holders, there should be judicial departments within the existing judicial system specializing in legal action against violation of the exclusive rights of industrial property owners.

In conclusion, it should be noted that national wealth and competitive advantages are largely generated through new knowledge and making it valuable through transformation to intellectual property. Considering global trends, Kazakhstan should accelerate the development of high-class competitive advantages, which are largely dependent on the quality and quantity of innovation, the protection of such innovation and its rate of introduction into economic circulation and effective management.

Science-intensive commodity market sectors are controlled mainly through exclusive rights arising from patent legislation. Therefore, it is vital that the national patent system can absorb the best international achievements and meet the needs of the global economy.

4.3. Effect of WTO accession on technologies in Kazakhstan

Kazakhstan's WTO accession is determined by national economic interests and will have a number of positive and negative effects on overall human development and technological development in particular. The WTO system promotes a trade-enabling environment including a stable, transparent and predictable market and safe investment.

Thus, WTO membership and liberalization of the domestic market of goods and services will both facilitate foreign investment in new technologies, production of high value-added products and market saturation with diverse produce and enable local products to reach foreign markets, intensifying competition on the domestic market.

WTO membership will promote the introduction of modern technologies and industrial engineering techniques, intensify competition on the domestic market and make local produce more competitive on foreign markets. It will also attract more foreign investment, which will be very timely for the processing industry, particularly innovative enterprises.

It is vital that Kazakhstan has a presence on the global high-tech market, both as provider of new scientific and technological ideas and solutions and as a user of effec-tive technologies to produce science-intensive products. It is only by integrating into global technological exchange and learning how to effectively market such a specific good as industrial property and technologies that Kazakhstan's capacity in science and technology can be retained and strengthened and industrial innovative processes intensified.

It is vital for Kazakhstan to have a presence on the global high-tech market, both as provider of new scientific and technological ideas and solutions and as a user of effective technologies to produce science-intensive products

Many local enterprises buy foreign equipment in order to modernize production and produce competitive products. The cost of foreign equipment is twice that of locally produced equivalents. However, the real cost is competitiveness both on the domestic and foreign markets. Foreign equipment has more competitive advantages compared to locally alternatives. Therefore, the real exchange rate of the tenge can be undervalued, tax dues increased and a protectionism policy pursued, but due to integration into the global economy and Kazakhstan's prospective WTO accession these mechanisms will become obsolete. The national high-tech complex should be developed, development of science and technology facilitated and breakthrough technologies forecast. These measures will stimulate the replacement of foreign products with local alternatives. An aggravating factor is the rapid deterioration of the scientific component of R&D funding. A reduction in government funding for science and development has resulted in many active development works, including such important areas as biotechnology, alternative energy, and high-strength materials, being wrapped up.

Linkages in the purchase and transfer of scientific and technological achievement often fail to go beyond technologies materialized in ready-made technological equipment. At the same time, the emerging market of advanced technologies and scientific and technological achievement related to marketing of intellectual property, licenses to use inventions, industrial designs and utility models or know-how and technology transfer agreements all greatly affect innovation.

Today, many high-tech developments, including those funded fully or partly from the national budget, are transferred overseas, which is detrimental to the national economy. On the other hand, sometimes agreements are made to purchase foreign technologies of low specification and effectiveness. These often fail to comply with environmental standards, involve unjustified costs and provide foreign licensors privileges that may conflict with anti-monopoly laws.

Moreover, uncontrolled imports cause technological dependence of the national economy on foreign countries and reduced demand for locally produced technologies.

WTO accession will not immediately result in a rapid increase in the production and export of new and advanced technologies

WTO accession will not immediately result in a rapid increase in the production and export of new and advanced technologies. The WTO promotes, primarily, marketing of ready-made and science-intensive products, while approximately two-thirds of Kazakhstan's exports are raw materials and fuels, which can, in any case, be marketed abroad without much limitation.

Another approach is taken towards imported goods and services, which, if in a great variety, can intensify competition, which local industries may not be able to bear at this stage. This is particularly true for food, pharmaceutical, chemical, mechanical engineering, light and electronic industries and such sectors as insurance, financial services, retail, small and medium-sized enterprise.

WTO accession will affect almost all sectors, while commitments or reforms will include import tariffs for manufactured products, business rights of foreign investors, agricultural policy and investment measures in trade.

State-of-the-art awareness-raising and information provided to commodity producers by authorized information agencies is an important aspect contributing to innovative activities of local enterprises

According to a study by the World Bank's expert group (J. Jensen, D. Tarr, 2006), after joining the WTO Kazakhstan's consumption will increase by approximately 6.7% (3.7% of GDP) in the medium-term and can reach 17.5% (9.7% of GDP) in the long-term based on positive effects on the investment climate. As for the cost of regulation, we estimate that about 2.3% of the local labor force will have to find other jobs. In most countries the standard turnover rate goes over this figure after a year.

An overall reduction in local tariffs will improve the distribution of internal resources, since the reduction will enable a shift to the sectors whose output is most valued in terms of global market prices. In addition, it will be easier for Kazakhstan's businesses to import new technologies, which will have a positive effect on productivity. However, under the most-favored-nation treatment, local tariffs for goods are already low, while in the CIS trade is in most cases duty-free. Therefore, this intervention is unlikely to have a significant effect.

No doubt, one of the positive implications of Kazakhstan's accession to WTO is liberalization of services and a resulting increase in foreign investment. Kazakhstan's obligations to transnational service providers will encourage more foreign direct investment in the national market. Local businesses will therefore have better access to services provided by transnational providers in areas such as telecommunications, banking, insurance, transport and other business services. This will lead to reduced business operation costs and increased productivity of local businesses using such services.

Today, enterprises involved in foreign economic activity are in need of reliable information.

Information support to local businesses is a pressing issue at the current stage of development. It is a multi-dimensional issue in terms of content, reliability and access. Irrespective of ownership patterns, commodity producers have to be pro-active to introduce innovation. Pro-activity should include awareness of what science and advanced practices have to offer in terms of production and processing of pro-ducts in different industries. Consequently, state-of-the-art awareness-raising and information provided to commodity producers by authorized information agencies is an important aspect contributing to innovative activities of local enterprises.

Equally important is setting up a special consulting service. Experience of advanced enterprises shows that in order to promote innovative activity continuous communication between producers and science and innovation groups is essential. However, direct communication is sometimes impossible. Therefore, innovation involves a service that seeks to promote the introduction of scientific achievement and best practice in production. Our opinion is that area-based chambers of commerce and industry should be advisory and act as coordination centers advocating the interests of producers of exported products. A system of such chambers has great and untapped potential to deliver a variety of business information.

The authors believe that liberalized services, a resulting increase in investment and a more competitive market of services will lead to transfer of the most advanced technologies, involving fewer costs and the development of a domestic market for scientific and technological products.

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In conclusion, it should be reiterated that *infrastructural support to innovation* should be studied in detail. This will allow to definition of the roles of the players, identify gaps in the innovation system and additional services to be provided to innovative enterprises to speed up the development of innovation systems in Kazakhstan. The role of the players in the innovative process includes functions such as financial support, information, marketing and consulting services, training and assistance with reaching markets through trade centers. The legal protection of intellectual property may facilitate innovative activity. Practice shows that there is a direct relationship between the legal protection of intellectual property and new products. All of the above factors and mechanisms are necessary to lay the foundations for the development of innovative processes that will enable the creation and use of new technologies for the benefit of socio-economic development in Kazakhstan.

CHAPTER 5. KAZAKHSTAN'S TECHNOLOGICAL CAPACITY

The effective development of science and technology is based primarily on justified priorities and the subsequent concentration of scientific capacity and financial and material resources on achieving those priorities

It will be impossible to ensure social and economic development and Kazakhstan's global competitiveness based on local technologies without national technological development policy and priorities. Priorities in science and technology are based on joint analysis and forecasts of science and technology and related markets.

The effective development of science and technology is based primarily on justified priorities and the subsequent concentration of scientific capacity and financial and material resources on achieving those priorities.

To this end, the government's support for research should concentrate on facilitating the maintenance and development of 'breakthrough' innovative projects, creating space and information technologies, nanotechnologies, biotechnologies and energy technologies.

The effective implementation of such projects will enable the creation of new products, the use of previously untapped resources and materials and will also create new national scientific schools and new jobs.

Today, Kazakhstan has a number of scientific groups undertaking research in nanotechnology and related disciplines[44]. These include synthesis of nanoclusters and nanostructures of semi-conducting and metal systems and development and designs of nano-size catalysts, sensor nanostructure materials and carbonic nanostructures.

Kazakhstan also has great capacity in biotechnology. In particular, biotechnology methods have been used to develop highly productive crops that are stress and disease resistant. Effective methods of immunological and molecular-genetic detection and prevention of particularly dangerous animal diseases have been developed and introduced. New micro-organism strains were obtained for the needs of the microbiology, pharmaceutical and food industries and environmental management. A collection of cultures of microorganisms for the production of microbiological medicines and biologically active substances has also been created.

The country also has capacity in the space industry, firstly, in material, technological and human resources. In particular, Kazakhstan has the Baikonur space center, which is a world-leading space launch facility. The experience of recent years shows that Kazakhstan has competitive advantages in this area. It is clear that a fully-fledged space system will not only enable the development of new technologies but also help meet growing national needs and generate good profits.

This allows us to conclude that the practical application of scientific outcomes will be a powerful catalyst, enabling the development of new technologies, products and materials, while retaining and modernizing existing technologies and markets of science-intensive products.

This chapter does not attempt to review all technologies. It focuses only on the following four technologies:

i. traditional technologies for natural resource extraction and processing;

ii. energy-saving technologies and alternative energy sources;

iii. biotechnologies;

iv. social technologies, the use of which in the real economy will not only advance national economic capacity but also ensure comprehensive and profound development of these areas promoting strategic priorities for the benefit of Kazakhstan's people.

5.1. Traditional technologies for natural resource extraction and processing

Kazakhstan is a country with rich mineral and natural resources[45]. Of the 105 elements in the periodic table, the country is home to 99 of them, with proven deposits of 70, while it uses 60 chemical elements in production. Kazakhstan accounts for 250 million out of 11 billion tons of globally extracted minerals, which places the country 11th in the world. In the ranking of extraction of 37 different elements, Kazakhstan is placed within a range of 1st and 19th.

Kazakhstan is expanding its presence on the market of energy producers. It is placed 19th in terms of oil extraction globally, 13th in gas production, 10th in coal production, 1st in tungsten and vanadium ore reserves, 2nd (23% of world total) in chrome ore reserves and 3rd in manganese ore reserves. Kazakhstan accounts for 25% of global reserves of uranium, 19% of lead, 13% of zinc and 10% of copper and iron.

However, most technologies currently used to produce non-ferrous and less

[44] N. Bekturganov "Nanotechnologies: Kazakhstan can be a world leader"/ http://www.liter.kz/site.php?lan=russian&id=147&newsdate=2006-1-01.
[45] The Industrial Kazakhstan, 3 (30) 2005.

Most technologies currently used to produce non-ferrous and less common metals fail to fully comply with modern environmental, cost-effectiveness and efficient mineral resource management requirements

common metals fail to fully comply with modern environmental, cost-effectiveness and efficient mineral resource management requirements. Its well known pyro-metallurgical processes using active technologies of metallurgic plants emit too many gaseous pollutants. Furthermore, middlings such as slag, mud, etc. accumulates at metallurgic plants taking up huge amounts of space.

In this regard, it is important to look at Kazakhstan's capacity to use natural resource extraction and processing technologies more effectively.

Mining and smelting complex

The metallurgy industry is a large sector of Kazakhstan's economy[46]. The major national mining companies, primarily the Eurasian Industrial Association, Mittal Steel Temirtau, JSC Corporation Kazakhmys and JSC Kazzinc, constitute a single industrial and economic complex embracing extraction, concentration and processing plants, energy and heat producing factories, and a developed infrastructure enabling financial, marketing and sales, as well as external economic, research and scientific works.

One of the indicators of a country's development is a wider range of use of less common metals, allowing conservation of natural resources, improved quality of produce and reduced energy and material costs

Kazakhstan's metallurgy has the competitive advantage of having good access to domestic mineral resources and raw materials. Domestically produced ores bearing non-ferrous metals have a complex structural and mineralogical composition, including a broad range of less common and trace elements.

In this regard, the priorities in metallurgic science and technology lie in:

- development of new technologies to allow sharp reductions in capital costs and emissions of harmful substances; use in production of collective concentrates, low-quality raw materials and middlings in order to use materials more effectively and expand the raw material base;

- introduction of effective technologies and modules to make pure metals, alloys and composite materials; development and use in production of a wide range of alloys bearing titanium, manganese, tungsten, molybdenum, zirconium, niobium, etc.;

- setting-up mini-productions based on modular technologies to meet domestic demand for metal products, including production of color coatings and aluminum; setting-up flexible automated production of low-alloy stainless steel.

Over recent decades, Kazakhstan's processing industry has extensively used complex ores, resulting in a situation where mining accounts for 15-20% of losses, the concentrating cycle for 60-70% and metallurgic processing for 15-20%.

In this regard, the priorities related to processing of manmade materials lie in:

- development of new technologies to process manmade second-hand materials, allowing valuable components to be turned into marketable products;

- research and development of new technologies for integrated processing of tin, nickel, tungsten and molybdenum and establishing production of these metals;

- research and development of priority technologies to make powdered metal and processing of non-ferrous metals;

- development of technologies to make lead and calcium, lead and nickel and other alloys;

- production of stainless steel to produce high-quality rolled metal.

One of the indicators of a country's development is a wider range of use of less common metals, allowing conservation of natural resources, improved quality of produce and reduced energy and material costs. In developed countries, consumption of fossil fuels and a number of traditional raw materials has been reduced by 20-25%, while consumption of less common metals has grown several times.

There are a number of factors hindering the production of less common and rare-earth metals in Kazakhstan. Firstly, Kazakhstan was not present on the market during the economic reform period and has no processing industries using less common and rare-earth metal produce. Also, inter-sector bonds between related enterprises were broken, while active enterprises pay little attention to recovering all valuable components from raw materials.

Extraction and processing can only expand through the development of new fields, integrated processing of not yet explored ores, terraces and tails and re-processing of blocks. To-date, Kazakhstan has accumulated over 20 billion tons of industrial waste, of which 10.1 and 8.7 billion tons are manmade waste, such as not yet explored ores, terraces and tails of non-ferrous and ferrous metallurgy respectively. For example, the development of ore deposits in Rudny Altai alone has left 360

[46] *The Industrial Kazakhstan, 3 (30) 2005.*

Box 5.1.1.

Mineral reserves

Kazakhstan has rich mineral reserves of less common metals, which, if managed effectively, can last for years and help build modern areas of national science and technology. Such complex ore fields as Kundybai, Akchatau, Verhne-Kairaktinsk, Svyatogorsk, Losev, Shokash, Satpaev and Obuhov have significant reserves of such rare-earth metals as cadmium, indium, thallium, selenium, tellurium, beryllium, tantalum, niobium, vanadium, gallium, scandium, rhenium, osmium, tungsten, molybdenum, zirconium and hafnium. These reserves are more than enough to meet domestic needs for less-common metals and can position Kazakhstan favorably on the global metal market, provided that local production is made competitive.

million tons of solid waste from mining production, containing some 2 million tons of copper, lead and zinc and some 120-130 tons of gold.

The limited use of solid waste is explained by a lack of:

- equipment to process different wastes or make such wastes ready for processing in other industries;
- cost-effective techniques to assess the effectiveness of environmentally friendly waste processing and provide economic incentives to enterprises;
- access to updated information on volumes of waste, physical and chemical characteristics and methods of use.

In order to ensure sustainable development of the mining complex, Kazakhstan adopted the Program for Development of Raw Material Base for the Domestic Mineral Complex for 2003-2010.

The Program aims to set up and develop an effective system of geological research to identify new mineral reserves and ensure effective management of mineral resources.

The main objectives of the Program are:

- geological and mineral mapping of ore areas;
- monitoring of mineral materials and mineral resource use;
- information support to geological research and mineral resource use;
- scientific and technological support for priority areas of geological research;
- geophysical research to study deep structure of the subsurface, etc.

The Program will facilitate productive use of low-grade materials, waste and terraces and attract highly qualified personnel and post-graduates to the mining industry.

Currently, the following negative trends can be observed in Kazakhstan's metallurgic complex:

- very limited commercial production of science-intensive, high-tech and special materials and alloys which would enable the development of modern production;
- limited range of rolled metal and metal ware products for use in mechanical engineering, oil and gas, mining, light, food and other industries and construction, heavy engineering and shipbuilding sectors;
- lack of commercial production of materials and metal ware based on new technologies, such as powdered metals, electrometallurgy, electroplating, new foundry and chemical technologies, etc.;
- ineffective use of recycled metal resources that may not be registered on the balance sheet or may be exported without control.

Another aggravating factor is that exports account for almost 100% of profits in metallurgy.

One other characteristic is the almost total concentration and monopolization of production and control stock owned by foreign investors. This results in the bulk of foreign investment being channeled into production that the investor can control.

The dynamics of global metallurgy and increasing prices should drive the development of the domestic metal and steel market. The country's rich raw materials base, infrastructure and labor resources determine the importance of building national capacity to generate products with high added value.

Overall, consolidation in Kazakhstan's metallurgy is a need. A way forward is consolidation of large enterprises, potentially metal processing and mechanical engineering enterprises, particularly in the oil and gas and energy sectors, that have better capacity to intensify development. At the same time, the government should encourage consolidation but prevent monopolization, since monopolists are not interested in promoting competitiveness through better internal efficiency.

Petrochemical and chemical industries

Oil and gas extraction is a national economic priority. Kazakhstan has rich proven hydrocarbon reserves including 2.1 billion tons of oil, 0.7 billion tons of gas condensate and 1.7 trillion m3 of gas and huge estimated reserves of 12 billion tons of oil, 1.6 billion tons of gas condensate and 5.9 trillion m3 of gas. These sectors currently account for 30% of GDP, some 80% of industrial production and over 80% of exports.

Kazakhstan has three oil processing plants using a primitive scheme of only atmospheric distillation of oil[47]. As for secondary oil processing, only catalytic reforming of once-run benzene and hydrofining of diesel fuel are carried out. Other processes such as vacuum distillation of atmospheric residue (reduced crude), catalytic and thermal cracking of heavy gas oil, hydro-cracking, alkalization of butane-butylene combination, isolation of aromatic compounds from reformed benzenes, processing of gaseous waste and many other processes are not in place. This leads to high cost of domestic oil and gas products that cannot compete with Russian, let alone international equivalents.

Kazakhstan has three oil processing plants using a primitive scheme of only atmospheric distillation of oi

Active enterprises of the chemical industry, such as the Atyrau polyethylene and polypropylene plant and Aktau polystyrene plant use imported materials such as ethylene, propylene and styrene and these plants are not profitable.

Box 5.1.2.

Oil products

In 2005 Kazakhstan produced 3,280,000 tons of diesel fuel, which is 118% of the 2004 figure and 146.7% of the 2001 figure. Similar trends can be observed in the production of reduced crude and condensed gas.

Local oil processing plants produced increasing quantities of oil products over the period 2001-2005. Thus, in 2003 11.2 million tons of oil were processed, which is 118.7% of the 2004 level. Doesn't seem to make sense. Wasn't the trend to increase production year-on-year? Perhaps it should be 2005, not 2003? (AN) – I guess he is right and this should be 2005. Could you please check and make respective corrections in Russian and Kazakh texts. Also I have changed the order of sentences in the box to avoid contradiction.

In 2005 2,356,100 tons of benzene were produced, which is 122.5% and 149.1% of the 2004 and 2001 figures respectively.

However, despite growing volumes of processed oil and oil products, imports are still high. For example, in 2005 31% of benzene was imported, 7% of diesel fuel, and over 50% of aircraft kerosene.

Constructed since independence, the most advanced installation – Karachaganak gas condensate plant – exports nearly all gas condensate required for high-octane petrol. At the same time, other local plants import the bulk of their required oil products.

Another concern is technology. Active oil processing plants process oil to 50-59% depth, not going beyond atmospheric distillation, while Russian plants have achieved 83% depth. Globally, the most advanced refineries can process oil and gas almost completely, without any waste.

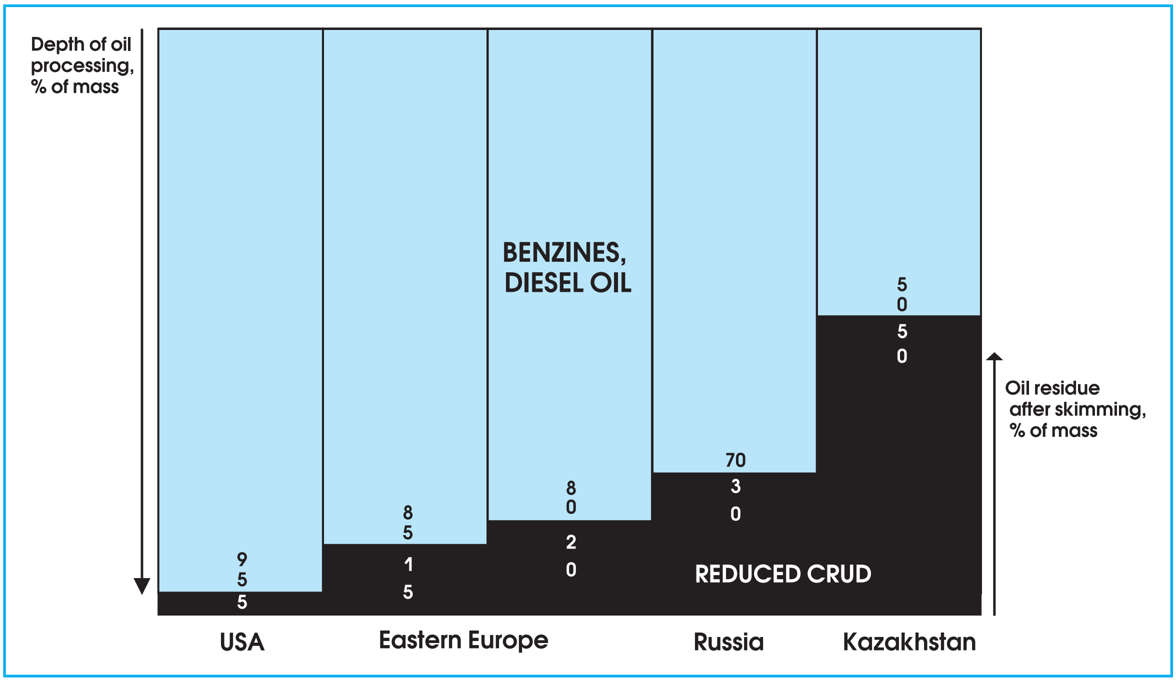
Achieving oil processing depth of 85-90% as in European countries is a burning economic and technological issue for Kazakhstan's oil sector (Figure 5.1.1.). The only way to expand production of high quality light-oil products is to build new facilities and modernize active production, with capacity for advanced and complete processing of reduced crude and tar oil.

Kazakhstan has great scientific capacity in chemical studies, while national scientific schools occupy a certain niche in global science. Scientific achievements in different areas of chemistry mean that local scientists are capable of finding solutions to not only fundamental targets but also applied industrial targets enabling proactive development of active and newly est-ablished chemical enterprises. However, the purely academic formulation of fundamental targets and their solutions make them unsuited to the needs of privatized industries in Kazakhstan. Foreign corporations managing industrial enterprises have no need for local scientific establishments, since they would better purchase new technologies from overseas.

In order to develop petrochemical and chemical industries, production should avoid focus on mono products. In petrochemistry and oil processing there is no industrial waste, since waste of from one production process is input material for another. Active oil processing plants only focus on production of fuel. For example, at the Shymkent petroleum refinery reformed gases containing up to 30% gaseous hydrogen and 10% light olefins C3-C4 are flared off. Currently, Kazakhstan does not produce hydrogen, which is required for operational hydrofining processes and hydrocracking, alkalization and other processes that will operate in future. Olefins such as ethylene, propylene, butylenes and isobutylene can be used as monomeric input materials for the Aktau and Atyrau plants.

[47] The Industrial Kazakhstan, 3 (30) 2005.

Figure 5.1.1. Depth of oil processing in different countries



Source: Reference of modern petrochemical processes, 2001 — Oil and gas technologies, issue 3, May-June, 2001, p. 94-137 in Gimaev R.N, Kurochkin A.K. "Technology of cardinally advanced oil processing"// http://termakat.ru/science

Local industry still uses reduced crude as fuel at heat stations, although it is reduced crude that is used to isolate the most expensive oil products, in particular, lubricating oils, which are not produced in Kazakhstan. It is also used to recover tar oil, which is an input material for the production of bitumen, extensively used in road construction. In addition, reduced crude is a cost-ineffective fuel, since 30% of the heat energy goes to heat up the reduced crude itself so that it can be placed in burners. When burning, reduced crude completely loses metals such as vanadium, nickel and cobalt contained in local oil and concentrated in heavy fractions.

Oil and gas materials can be used not only for fuel and energy purposes. Through petrochemical synthesis and extensive processing, a wide range of products can be produced that can substitute for other natural resources. This is a very cost-effective technique.

International experience shows that petrochemical production is most effective in vertically integrated oil and gas companies consolidating oil companies producing hydrocarbon materials and chemical technologies and ensuring R&D.

Sulfur and gas recovery is one of the most important issues in Kazakhstan's petrochemical industry.

In this regard, hydrogen sulfide should be used more extensively in the petrochemical industry. The difficulty is that petrochemical production is underde-veloped in Kazakhstan, since accom-panying the gas is traditionally flared off. A sharp increase in oil recovery and flaring may further worsen the already serious environmental situation in western Kazakhstan.

Sulfur and gas recovery is one of the most important issues in Kazakhstan's petrochemical industry

Box 5.1.3.

Advanced technology

In order to reduce the environmental impact of sulfides, the Karachaganak oil refinery tested an advanced technology, which allowed pumping of gas containing up to 19% of hydrogen sulfide back into the layer. This enables better seismic safety, since layers are not empty, and increased oil recovery through increased pressure in layers, which reduces the huge costs required for construction of oil processing productions.

In the long-term, Karachaganak-tested technology will be used in Tengiz and the marine fields of Kashagan. However, this is not a perfect solution, since only up to 75% of accompanying gas can be pumped back into the layer.

In order to effectively introduce advanced hydrocarbon extraction and processing technologies, a mechanism to engage all companies (private, government-owned and mixed) in the process should be developed

Therefore, active processing production should be modernized, while new production complexes should be built capable of processing gas and isolating sulfur.

Environmentally friendly production

Petrochemical and chemical industries are basic segments of Kazakhstan's economy, laying the foundation for its long-term and sustainable development. To this end, the Program for Development of the Chemical Industry of the Republic of Kazakhstan for 2006-2011 was developed. The Program aims to promote the competitiveness of the sector on domestic and international markets through en-hanced national scientific and tech-nological capacity.

To achieve this, based on the Medium-Term Plan for Social and Economic Development of the Republic of Kazakhstan for 2007-2009 (second phase) approved by Governmental Decree #822 of 25 August 2006, the following should be ensured: saturation with competitive produce; building export capacity and developing import-substituting production (primarily through more advanced and complete processing of hydrocarbon materials); use of innovative technologies and devices and the production of a wide range of competitive petrochemical products with high added value using science-intensive and resource-saving environmentally fri-endly technologies complying with inter-national standards ISO 9000 and 14000. To this end, major targets include:

1. development of new environmentally friendly chemicals for alimentation and protection of plants, plant growth and development regulation, biopreparation, protectants, herbicides and defoliants:

• ammoniated calcium phosphate, fluorine-free ammophos and ammophosphate, etc.;

• biological, microbiological, organic mineral and micro-fertilizers through the use of off-balance materials (brown coal) and secondary waste (phosphorite fines, lime slurry, etc.) and recovery of organic mineral fertilizers of multiple use with good nutritious components.

2. setting up of environmentally friendly production of synthetic detergents complying with international standards, i.e. phosphate-free:

• production of zeolites at the Pavlodar Aluminium Plant;

• production of active basis (alkyl benzene sulfonic acid and alkyl benzene sulfonate) at the Pavlodar Petrochemical Plant.

In order to become one of the world's 50 most competitive countries, Kazakhstan should introduce new technologies more extensively for the extraction and processing of hydrocarbon materials.

Such technologies include new techniques enabling more recoverable oil using non-traditional heat sources, utilization of waste of the nuclear power industry, new techniques for identification and development of fields in the Caspian Sea without impacting on the marine environment, new storage methods for produced sulfur and management of produced gas, etc.

New technologies will enable a 20-30% increase in recoverable oil, effective nuclear waste management and improved an environmental situation in hydrocarbon extraction areas and contribute to the development of advanced technologies, in particular underground primary oil recovery (underground cracking), isolation of benzene and other fractions.

In order to effectively introduce advanced hydrocarbon extraction and processing technologies, a mechanism to engage all companies (private, government-owned and mixed) in the process should be developed, so as to interest them in increasing oil recovery and improved environmental management. In doing so, international practices should be considered, in particular those from the USA, where such a mechanism exists at the national level and involves all stakeholders.

5.2. Energy-saving technologies and alternative energy sources

Energy-saving technologies

Kazakhstan has rich energy resources, both traditional and alternative, while the energy sector is one of the most developed sectors of the economy. Energy reserves are substantial to meet both domestic and export demand.

Effective use and management of fossil fuel (coal, oil and gas), increased effectiveness of energy consumption in all sectors and development of renewable energy sources (biomass, hydroelectric power, solar and wind energy, geothermal energy and other sources) can all combine to help meet human energy needs and, as a result, ensure sustainable human development on the global scale.

Energy management or improved energy management can be viewed as identification and implementation of measures and instruments to meet needs for goods and services with the minimum economic and social costs of required energy and minimum cost required for environmental management, thereby enhancing sustainable development on the local, national, regional and global levels.

Industrially developed countries, primarily those with ineffective energy management, can significantly reduce energy consumption without implications for living standards or their economies. Developing countries can enhance welfare through a reduction in energy consumption that is higher than developed countries had in the past. In both cases, energy saving becomes an important factor in improving both economic performance and environmental quality.

Energy saving is an economic development factor that has proved that in many instances it is more cost-effective to save energy or not use it at all than to increase energy production. This means that the financial resources allocated to enhance energy production or increase energy imports could be channeled into other areas, for example improving living standards, comfort, transport and construction of hospitals.

In addition to the freeing up of financial resources, effective energy management also promotes production through improved productivity and more competitive industry. It should be remembered that domestic production of advanced energy-effective equipment will enable integration into foreign markets.

The environmental benefits of better energy management are obvious, since energy with less environmental impact is energy that does not need to be consumed or produced. In all cases, reduced energy consumption for different purposes (through better thermal protection of housing, improved efficiency of engines, etc.) will automatically enable a proportional reduction in emissions of pollutants.

Improving fuel and energy management is the most cost-effective way to protect the environment. In addition, environmental benefits are like cost-free awards compared to, for example, the costs of special en-vironmental management and pollution control measures. Therefore, energy-saving action should be a top priority in national environmental policy.

Over the last decade, Kazakhstan with its rich but highly ineffectively managed fuel and energy resources has, finally, come to recognize the need for more efforts to introduce large-scale energy-saving schemes in all sectors of the economy. The high level of intensity of energy use in the national economy - on average 3 times higher than in leading industrial countries - is a heavy burden on national and local budgets, reduces the competitiveness of domestic produce and adds to environmental stress. Today, this is recognized widely.

Box 5.2.1.

Heat saving in rural areas of Almaty oblast

Research has shown that actual heat consumption is 25-30% more than estimated use of heat in rural households and sometimes the figure is even higher. This is caused by poor heat-saving characteristics of materials and misuse of basic building specifications and technologies. At the same time, limited financial resources prevent the use of heat-saving technologies and modern building materials in rural areas. This necessitates the development and introduction of inexpensive technologies using traditional materials.

Under the GEF/SGP project "Heat saving in rural areas of Almaty oblast", training workshops have been conducted, while heat-saving projects have been piloted in Ryskulov and Almalyk villages of Talgar rayon and Amanbokter village of Sarkand rayon, Almaty oblast. Also, energy assessment and energy saving actions were taken, while some heating facilities were improved. The project financed thermal protection of 10 houses owned by low-income families in three villages.

All experiences were documented in a manual "Heat saving in rural houses" describing the heat saving technologies which used locally produced construction materials.

Assessment of the thermally protected houses showed that they all consumed much less fuel such as firewood, coal or compressed dung. Rural residents noted reduced fuel costs, which helped save the family budget. Therefore, the project helped to both reduce energy consumption and improve the welfare of rural people. The thermal protection of houses involved affordable and accessible materials, allowing replication of this approach in other villages.

However, mere recognition or indication of a willingness to take energy-saving action to promote a national energy-saving policy is not enough. At the level of end user this requires, first of all, skills as to how to do it and identify required technological, financial and organizational resources. On a wider scale, as experience of developed countries with more energy-efficient eco-nomies shows, a plan of action for organizational, institutional, legal, financial, scientific, technological and educational components of energy-saving policy should be developed. The plan should be based on awareness of available energy-saving techniques in each economic sector, and selection of the most appropriate criteria for different categories of energy users, and prioritization.

Mere recognition or indication of a willingness to take energy-saving action to promote a national energy-saving policy is not enough

Energy policy based on alternatives and a structurally changed economy does not necessarily imply that new fields should not be developed or new electric power stations not be built. If there is a need and the potential for energy saving is limited, they should be put in place. Some fields are exhausted, which requires new sources of energy to prevent a sharp reduction in energy production. It should be noted that it takes time to change the economy structurally and set up energy-saving systems. In this context, it is necessary to explore and develop new fields and build energy capacity, which is a matter of the scale of and priorities in resource distribution. From an economic standpoint, it is obvious that it is impossible to effectively combine extensive growth of energy production and energy-saving policy and reconstruction. Even now, the bulk of investment goes to the heat and energy complex, while an increase in such investment will have very negative implications for other economic complexes and sectors.

It is necessary to identify energy priorities and channel the bulk of investment there, either to further promote high finance-consuming energy production based on newly constructed power stations and increasingly expensive development of fields with great environmental, economic and social costs, or to encourage end results based on energy saving. All international practice shows that energy-saving economic development is much more effective from economic, en-vironmental and social perspectives.

Internationally, the following measures are taken to save energy:

- economic and legal incentives for energy saving;
- differentiated peak/off peak tariffs for electricity to be paid by municipal enterprises;
- introduction of automated meters for heat, water and gas;
- introduction of heat management systems in different buildings;
- introduction of local electric heat stations and heat reservoirs working under privileged regimes;
- reconstruction and technological upgrade of energy generating sources, heat, energy and water supply networks;
- electronic starting controllers for gas-discharge lamps and automated street light management systems;
- variable-frequency drives for engines used in municipal utility services;
- central control over municipal energy carriers;
- introduction of highly efficient energy sources;
- differentiated peak/off peak energy tariffs for municipal utility services.

The introduction of modern science-intensive technologies requires qualified specialists to be involved at the stages of development, introduction and operation

The introduction of modern science-intensive technologies to automate technological processes and save energy both in housing and industries requires qualified specialists to be involved at the stages of development, introduction and operation.

Such specialists should be able to both provide professional advice to clients selecting equipment and maintain such equipment at all stages of operation, ensuring that clients have the required operating information and support to modernize and upgrade the equipment.

Given that energy and resource saving issues are interlinked and growing more important each year, such issues should be included in the training programs of enterprises and engineering courses offered by higher education establishments.

Alternative energy

Currently, from an energy perspective Kazakhstan can be divided into three regions:

northern and central region embracing Akmola, East Kazakhstan, Karagandy, Kostanai and Pavlodar oblasts with shared economic networks and links with Russia;

southern region including Almaty, Zhambyl, Kyzylorda and South Kazakhstan oblasts with shared electric network and links with Kyrgyzstan and Uzbekistan. In 1998 the southern region was linked to the northern region;

western region including Aktobe, Atyrau, West Kazakhstan and Manghistau oblast, which are linked to Russia, while Manghistau, Atyrau and West Kazakhstan oblasts share an electric energy network with the energy sector of Aktobe oblast working independently.

Kazakhstan's electrical power industry is based on coal (using cheap Ekibastuz coal). The coal and energy industries enjoyed large investment in the past, ensuring their long-term development.

Currently, Kazakhstan's electric power stations have a certain capacity to meet domestic needs and provide for imports to the southern and western regions due to the previously established network.

One of the indicators of performance of capital equipment of heat power stations, which account for around 85% of Kazakhstan's power industry, is fuel consumption to generate 1 K.W.H of electric energy. This indicator in Kazakhstan exceeds international standards by 10-15%, which is largely associated with the use of low-quality coal and the need to upgrade and modernize equipment, especially at local heat power plants.

Kazakhstan's energy capacity should be built, new heat power stations constructed, equipment upgraded and active electric power stations expanded through the use of the latest achievements in science and technology. Effective energy use is a requirement for economic and social development and improved environmental situation.

Box 5.2.2.

Using wind energy in remote pastures

Under the GEF/SGP project "Using wind energy in remote pastures" shepherd families living in two settlements engaged in pasture-based cattle breeding were provided with autonomous energy supply systems through the installation of wind energy devices. This significantly improved their living standards and helped them to access water and process cattle produce. This project is a demonstration of the potential for electrification of remote rural settlements through alternative energy sources.

The sun serving rural people

The climate of Southern Kazakhstan allows use of solar energy 300 days a year to process fruits, vegetables and medicinal herbs.

The GEF/SGP project "The sun serving rural people" brought into operation the canning and drying of fruits and vegetables, kitchen and medicinal herbs through the use of solar energy.

To date, the suggested approach has proved cost-effective, while monitoring of rural awareness shows that most rural residents are sure that the technology is an important and much-needed tool for poverty reduction.

Therefore, Kazakhstan has prioritized alternative energy sources such as water, wind and solar energy, biomass, etc., for which Kazakhstan has great potential, in order to develop the electric power industry and address current environmental issues.

Just like the rest of the world, today and in the future Kazakhstan should use renewable energy sources to help save traditional energy reserves.

Renewable energy resources or alternative energy sources are effective in generating electrical energy at the local level and meeting the needs of remote rural areas.

Today, the following energy sources are under development in many countries:

- Hydroelectric power stations;
- Wind energy;
- Photoenergy;
- Biomass;
- Solar heat;
- Solar energy;
- Geothermal energy;
- Marine energy generated through tides and waves.

The table 5.2.1 shows contributions of renewable energy sources to the global energy balance[48].

Kazakhstan has significant resources of renewable energy in the form of water, wind and solar energy. Hydroelectric power capacity is estimated at 27 billion kWh per year and wind energy at 1,820 billion kWh per year. However, although limited, water energy is not used to the full, while rich renewable energy resources could be used to supply energy to adjoining regions. From geographic and meteorological perspectives, Kazakhstan has great capa-city for wind energy. However, there are factors hindering progress in this area such as centralized energy supply by large electric power stations and low energy tariffs that fail to capture the long-term costs of upgrading equipment and environmental costs. These factors hamper the development of renewable energy sources.

Development of alternative energy could have positive effects on Kazakhstan's social development. The use of renewable energy would be cost-effective in many regions currently lacking adequate capacity. The use of renewable energy sources looks particularly attractive in regions with a decentralized energy supply and those with relatively high cost of fossil fuel.

Kazakhstan has significant resources of renewable energy in the form of water, wind and solar energy

[48] E.S. Pantshava, V.A. Pozharnov "Russia as the potentially largest provider of biofuel to the global market"// http://www.courier.com.ru/energy/en0605pantskhava.htm.

Table 5.2.1. Estimated contributions of renewable energy sources to the global energy balance (%)

Technology	Years				
	1996-2001	2001-2010	2010-2020	2020-2030	2030-2040
Biomass	2	2,2	3,1	3,3	2,8
Large hydropower plants	2	2	1	1	0
Small hydropower plants	6	8	10	8	6
Wind	33	28	20	7	2
Photoenergy	25	28	30	25	13
Solar heat	10	16	16	1	7
Solar energy	2	16	22	18	15
Geothermal	6	8	8	6	4
Marine (tides, waves)	-	8	15	22	21

Source: A.Zervos, Ch. Lewis, O.Shave, Tomorrow's world, "Global renewable energy", 2004, part.7, paragraph 4

However, renewable energy is not used widely in Kazakhstan, primarily due to lack of information, lack of commercial proposals for renewable energy sources and back-up services, lack of economic and financial incentives and lack of engineers and scientists capable of dealing with organizational, technological and environmental issues resulting from such use in different sectors.

Renewable energy is not used widely in Kazakhstan, primarily due to lack of information, lack of commercial proposals for renewable energy sources and back-up services, lack of economic and financial incentives and lack of specialists in the field

Below we examine the capacity for and challenges in using renewable energy sources in Kazakhstan.

Water energy

Kazakhstan's water energy capacity is estimated at some 170 TW per annum, of which current output only reaches 23.5 gW per annum (30 %).

The bulk of national water energy resources are concentrated in Eastern and South-Eastern regions. The Irtysh river, with its full-flowing right-bank feeders, including the Bukhtarma, the Uba and the Ulba, form the basis of the hydrographic network of Eastern Kazakhstan. Major hydroelectric power stations are located on these rivers. These are Bukhtarminskaya (675 mW), Shulbinskaya (702 mW) and Semipalatinskaya (312 mW).

Such rivers as the Ili, the Charyn, the Chilik, the Karatal, the Koksu, the Tentek, the Hergos, the Tekes, the Talgar, the Bolshaya and Malaya Almatinkas, the Usek, the Aksu and the Lepsy all have potential for hydroelectric power generation.

The construction of the Mainak hydroelectric power station with a capacity of 300 mW on the Charyn, as well as the Kerbulak hydroelectric power station on the Ili as a counter-regulator for the Kapchagai station, envisage further development. These stations will enable reduced energy deficit in South Kazakhstan by 900 million kWh. The construction of new energy facilities in energy-scarce regions using water resources will enable better energy supply and reduced dependency on energy transported from energy-abundant regions. It is expected that by 2010 new and old hydroelectric power stations will together produce 10 billion kWh. Kazakhstani scientists have developed over 480 designs of small hydroelectric power stations with a total capacity of 1,868 mW and average annual energy output of 8,510 gWh.

Wind energy

Kazakhstan's fairly rich wind energy resources remain almost untapped in terms of electricity generation.

Geographically and meteorologically, Kazakhstan is a country with great capacity for wind energy use. The country's annual wind energy capacity is estimated at 1,820 billion kWh.

In Kazakhstan wind energy facilities are of particular importance for rural areas where electrical energy is scarce. However, an informed approach should be taken to purchasing and using wind energy generators, looking at both cost and efficiency, since cheap technologies may be environmentally unfriendly.

Globally, the average cost of large wind energy generators is USD1,000 per 1 kW of output, while generators made in China can produce energy at a lower cost of USD600-700, but this may affect their quality, efficiency and reliability.

These sites were selected by a review undertaken within the UNDP-Government of Kazakhstan project "Kazakhstan Wind Power Market Development Initiative". One of the major selection criteria was average annual wind speed at the height of 50 meters. To detect the speed, special meteorological surveys were conducted for at least one year using 50 meter high meteorological masts.

Table 5.2.2. Status of wind energy around the globe

Country/ region	Current capacity	Targeted capacity	
Europe	34,205 megawatt	75,000 megawatt by 2010	1,180,000 megawatt by 2020
USA	6,740 megawatt		100,000 megawatt by 2020
India	3,000 megawatt	4,000 megawatt by 2006	
Japan	740 megawatt	4,000 megawatt by 2006	
China	700 megawatt	4,000 megawatt by 2006	20,000 megawatt by 2020
Australia	380 megawatt	4,000 megawatt by 2006	13,000 megawatt by 2020

Source: Bulletin of the RK National Engineering Academy, issue 2 (20) 2006.

UNDP supported such surveys for only two sites in Kazakhstan - the Djungarskiye Vorota and the Shelekskiy Corridor that can now be classified as potential sites for wind power stations.

Currently, the UNDP wind power project supports surveys to be held at another eight sites, which will help to determine whether they can be potential sites for wind power stations.

The RK Governmental Decree #857 "On Wind Energy Development" of 25 August 2003 was the first step towards international commitments Kazakhstan undertook as part of the UND Framework Convention on Climate Change ratified by RK Presidential Decree #2260 of 4 May 1995. The Decree initiated the construction of a pilot wind power station with a capacity for 5 mW in the area of the Djungarskiye Vorota, as part of the UNDP/GEF project.

Wind energy development will not only help to tackle the energy deficiency of some regions, including remote rural areas, but also improve the socio-economic status of the population. Access to energy will enable better water supply and agricultural productivity, new production, say, primary processing of raw materials and foods, and local crafts. Thus, wind energy, alongside other ongoing measures, can contribute to Kazakhstan's sustainable development.

Solar energy

Solar energy can be used primarily for hot water supply through solar collectors. Expert estimates say that by using solar energy for hot water supply needs, some 13 million Gcal of heat can be generated, allowing a saving of over 1 million tons of oil-equivalent fuel.

Presently, solar collectors are not widely used to heat water due to high cost (USD200 per 1 м^2 for imported collectors)[49]. If produced domestically, they can be cheaper, allowing much wider use.

Also, solar energy can be used to generate energy through photoelectric converters. Photoelectric panels can be used to generate small volumes of electricity for lighting and TV broadcasting needs in small rural farms and shepherd settlements without access to power lines. Solar photoelectric battery-based panels used for lighting needs can be more efficient than oil lamps. It is estimated that there may be a market for some 20,000 20-watt solar panels in Kazakhstan.

Table 5.2.3. Potential sites for construction of wind energy stations (WES)

№	Site	Oblast	Average annual wind speed, meteo data, mps	Estimated average wind speed, Global atlas, at 50 m height
1.	Zharminskaya	EKO	5,6	6
2.	Ereimentau	Akmola	5,4	7,7
3.	Stepnogorsk	Akmola	5,9	7,0
4.	Karkaralinsk	Karagandy	4,4	7,7
5.	Egindybulak	Karagandy	-	7,7
6.	Arkalyk	Kostanai	5,7	6,2
7.	Sakryl	WKO	5,2	6
8.	Atyrau	Atyrau	4,4	7,3
9.	Karabotan	Atyrau	-	7,7
10.	Akkistau	Atyrau	5,5	6
11.	Inder	Atyrau	5,4	6
12.	Prorva	Atyrau	6,2	7
13.	Fort-Shevchenko	Manghistau	6,0	8,2
14.	Sai-otesh	Manghistau	-	7,8
15.	Kordai	Zhambyl	5,1	6,2
16.	Aralsk	Kyzylorda	4,9	5,2
17.	Karmakchinskaya	Kyzylorda	5,5	5,2
18.	Chayan	SKO	5,0	5,8
19.	Sastobe	SKO	-	8,5
20.	Zhanamysk	SKO	-	8,5
21.	Djungarskiye vorota	Almaty	7,5	9,7
22.	Shelekskiy corridor	Almaty	5,8	7,7

Source: data of "Kazakhstan Wind Power Market Development Initiative", joint project of UNDP and the Government of Kazakhstan

The main factors hampering the development of solar energy are lack of semi-conducting silicon, global output of which is only a few percent of metallurgical silicon output, and the high cost of solar silicon.

A combination of solar panels and wind power stations to drive water pumps can improve water supply.

The scientific basis for silicon production was built within the Physics and Technology Institute of the Scientific Center for Chemical and Technological Research. In this regard, the production of semi-conducting silicon is noteworthy. The technology has no equivalents and completely skips the carbothermal and chlorsilane process stages, which, in the long run, will help develop solar energy in Kazakhstan.

[49] *TERRA-Zher-Ana. Solar energy in Kazakhstan/ http://www.solar-ct.com/articles/17.*

Box 5.2.3.

Advantages of biogas

As of early 2000, 300 cars in Stockholm use biogas with another 3,000 cars to start using biogas in the future. In 1990 in Linschoping, Sweden, 64 buses and two taxi parks (Volvo, Mercedes, Neoplan/Cummins) were converted to biogas. In Gavle, biogas is used to generate heat and electricity and as fuel for buses. In Trollhattan, buses run on biogas generated through meat and fish industry waste. 1 cubic meter of purified biogas is Euro 1.11 cheaper than petrol.

Biogas has the following advantages over other energy sources:

- *renewability;*
- *uses local sources of raw materials to produce fuel;*
- *reduced greenhouse effect;*
- *reduced dependency on foreign suppliers of oil and gas;*
- *less environmental impact through organic waste collection;*
- *an environmentally closed energy system.*

Biogas

The use of traditional energy sources in rural areas is hampered by lack of materials, high costs, lack of effective credit mechanisms, great risks and lack of services

Biogas is a gaseous product recovered through anaerobic, airtight, fermentation of organic substances of various origins. It mainly consists of methane (55-70%) and carbonic acid (28-43%), as well as small proportions of some other gases.

Cattle breeding waste is a stable source of biomass for energy production in Kazakhstan. Annual output of dry cattle and poultry breeding waste totals 22.1 million tons or 8.6 billion m3 of gas (13 million tons from cattle, 6.2 million tons from sheep, 1 million tons from horses), plant residues – 17.7 million tons (12 million tons from wheat, 6 million tons from barley or 8.9 billion m3), which is equivalent to 14-15 million tons of conventional fuel or 12.4 million tons of reduced crude or over a half of oil output. It is important to process already accumulated cattle breeding waste, which can generate about 2 million tons of conventional fuel per year (biogas).

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All energy sources non-traditional for Kazakhstan have similar strengths and weaknesses.

On the one hand, serious expert groups have conceptualized and justified their extensive use based on international practices. Also, they bring great economic, environmental and even social benefits by creating new jobs, triggering the development of domestic mechanical engineering and science to meet the needs in these areas, reducing health problems caused by emissions from power stations, etc.

The positive factors include traditional skills people use when using alternative energy sources such as sun, wind and water. In southern regions people use solar energy to heat water, dry, prepare adobes, as well as dung. In western regions, people use water engines to pump and lift water from the ground and water wheels to lift water in river-based regions. Also, rural people still extensively use woody plants as fuel for heating and cooking. Although dung is extensively used in rural areas, it is medically unsafe due to the risk of helminthiasis and other diseases, which have high incidence rates in rural areas.

On the other hand, certain factors hamper the development of these energy sources. Such a common issue as lack of funding also affects traditional energy sources. Another issue specific to non-traditional energy sources is lack of public awareness.

These issues are being addressed through pilot projects and promotional campaigns. However, there are certain barriers that can only be removed by government. In particular, lack of economic incentives, deficient or lacking legal framework and energy tariff policy. The current situation fails to encourage monopolistic energy companies to find ways to reduce costs. The use of traditional energy sources in rural areas is hampered by lack of materials, high costs, lack of effective credit mechanisms, great risks and lack of services.

Box 5.2.4.

The staff of the Karagandy Ecomuseum developed several technologies to construct biogas facilities for rural people and farmers[50].

This environmentally friendly project is also cost-effective. Waste from three cows (or six pigs or 25 chickens) can be enough to meet a family's domestic gas needs.

The Karagandy experience shows that a facility with capacity for 8 cubic meters running on pig dung can completely replace propane consumed to cook a meal for a family of five. A facility with capacity for 60 cubic meters can be used to heat a living space of 200 square meters or a working area of 400 square meters.

5.3. Biotechnologies

The Strategy for Industrial and Innovative Development of the Republic of Ka-

[50] *TERRA-Zher-Ana. What is a biogas plant and how it works./ http://www.solar-ct.com/articles/17*

zakhstan for 2003-2015 identifies biotechnology as a priority. Under the Strategy, the Concept of Development of the National Biotechnology Center of the Republic of Kazakhstan for 2006-2008 and science and technology program "Development of Modern Tech-nologies to Shape a Biotechnology Cluster in the Republic of Kazakhstan for 2006-2008" were approved by Governmental Decree.

Biotechnology means a type of technology using biological systems, living organisms or their derivatives to produce or modify products or processes to then be applied in practice.

Biotechnology refers to the science and practice of studying methods of adjusting the environment to human needs, i.e. making products useful for human beings through biological agents.

It is not coincidental that experts believe than biotechnology will determine the future development of different spheres of human life.

Below are some of the possible areas of application.

Biotechnology and agriculture

Today over 40% of Kazakhstan's population live in rural areas. In 2004 one third of all employed people were employed in agriculture, which indicates that even small-scale introduction of biotechnologies may result in large-scale implications for human life and development.

Agricultural biotechnology includes plant protectors, veterinary biotechnology, transgenic plants and animals. Kazakhstan exports some crops, such as wheat. At the same time, some regions are short of fresh vegetables. For example, in spring 2006 allocation was made from the Karagandy oblast budget to buy 100,000 tons of Uzbek vegetables.

Agricultural revenue varies from year to year depending on yield, which is currently lower than in developed countries. For example, in 2004 wheat yield was only 8 hwt per hectare versus 29 hwt in the US. Losses of up to 30% in crop yield occur through pests, diseases and weeds. Agricultural biotechnology aims to increase crop productivity both in quantitative and qualitative terms, to develop and use new sorts of crops, introduce special crops, etc.

National scientists have developed new and highly productive crops, high-value genotypes of cattle based on biotechnology. However, analysis shows that such new developments are not widely applied. In 2004, areas under crops of Kazakhstan selection totaled 3.4 million hectares (27.8%) versus 4.6million hectares (35.0%) in 2005. This indicates an upward trend in areas assigned to local crops.

However, there are remarkable regional disparities. In 2005 significant areas under crops and grains of Kazakhstan selection were registered in South Kazakhstan (95%), Almaty (95%), Zhambyl (93%) and Kzylorda (83%) oblasts.

It should be noted that as a branch of biotechnology veterinary biotechnology makes a great contribution to biotechnology as a whole in Kazakhstan. In cattle breeding, production of vaccines and veterinary medicines is growing. In addition, Kazakh-stani scientists are undertaking research related to avian flu and vaccines. In 2004 Kazakhstan purchased some 40 vaccines and veterinary medicines. Domestic output of veterinary drugs cannot meet national needs, while imports of veterinary medicines are growing annually. Given that veterinary vaccine production technology is simple and well-known, this has the potential to be a competitive area requiring little input.

As for biotechnological plant protectors, biopesticides are an alternative to chemical pesticides and are more environmentally friendly.

In light of WTO accession the country will have to intensify development and use of local crops, first of all, wheat, since now Kazakhstan uses mainly Russian varieties of wheat, which local producers will have to pay for after the accession. Traditional selection takes a long time to cross and develop a new variety (at least 8-10 years). Biotechnology reduces this period by several times and allows development of new varieties of plants with specified characteristics such as high-yield, drought resistance and content of certain nutrients.

Agricultural biotechnology aims to increase crop productivity both in quantitative and qualitative terms, to develop and use new sorts of crops, introduce special crops, etc

Biotechnology and healthcare

Medical biotechnology has significant implications for human life and deve-

Despite the fact that Kazakhstan has some capacity to produce pharmaceutical products, most medicines are currently imported

lopment. The global market for pharmaceutical products accounts for about half of the overall biotechnology market.

Kazakhstan has some capacity to produce pharmaceutical products. However, most medicines are currently imported.

Production of biotechnological blood specimens, genetically engineered drugs, immunological medicines, biosensors and biochips, etc. can, in the long run, improve national healthcare and ensure wide access to effective and affordable medicines.

The cloning of the sheep Dolly and decoding of the human genome open unique windows for progress in science and technology that can have a huge effect on human life. For example, medical scientists are now working to determine which genes are in charge of disease incidence and what can be done to prevent and treat such diseases.

Biotechnological methods are most extensively used to produce oil and purify environmental objects from oil pollutants

At the same time, each particular case of expensive universal medical techniques and technologies, which will, no doubt, be socially important, can involve risk. For example, it is ethically impossible to have a morally justified unambiguous attitude to cloning, transplantation, gene engineering, etc. In this regard, issues arising from the introduction of new medical technologies should be carefully studied and a legal framework for bioethics developed to protect health as a public benefit and to ensure survival.

Biotechnology and extracting industry

Currently, international practice shows that biotechnology based on different micro-organisms is increasingly used in the extracting industry. Biotechnological methods are most extensively used to produce oil and purify environmental objects from oil pollutants.

Existing oil field development technologies only allow extraction of up to 50% of oil reserves. In simple terms, biotechnology can be used in oil extraction as follows. Micro-organisms capable of growing under a wide range of temperatures, pressure and salinity, aerobic and anaerobic conditions are introduced in a layer and use oil as a nutrition source. Such micro-organisms can generate different metabolites such as gases, acids and surface-active substances through microbiological synthesis occurring in the layer, which ensures purity and improves oil recovery up to 40%. However, the most topical theme is mitigation of oil recovery effects both on the water surface and adjoining coasts. Recently, more attention has been paid to microbiological methods and use of energy-producing bacteria.

Biotechnology-based industrial gold mining facilities are used in metallurgy. Such facilities have enabled approximately 60% more gold recovery. In addition, they are cost-effective through reduced capital and operational cost and make recovery more environmentally friendly.

Biotechnology and energy: biofuel

In this area, biotechnological developments can be used to add to bioethanol gasoline and as fuel (biodiesel) for diesel engines. Such qualities as high explosive stability, low toxicity and use of renewable sources for production make bioethanol and biodiesel important materials in today's context. Bioethanol is a liquid alcohol fuel with fumes heavier than air. It can be made of agricultural products containing starch or sugar, for example, corn, crops or sugar cane, through biotechnology-based fermentation of plant mass. Biodiesel refers to methyl ethers of fatty acids recovered from vegetable oils such as rapeseed, palm and other oils.

Another advantage of these energy sources is that they are almost inexhaustible, which is not the case with fossil fuels such as oil and gas.

With its vast territory, Kazakhstan could allocate the large areas required to cultivate the required cultures and produce biofuel for both domestic needs and exports to neighboring countries.

Burning ethanol from plant fiber emits 10 times less carbon dioxide, a greenhouse gas, than burning petrol. In the USA, Sweden and Brazil ethanol has been used to add to petrol in order to reduce carbon emissions.

It would appear to be profitable for Kazakhstan to recover bioethanol as a by-product of deep wheat processing. Kazakhstan's solid varieties of wheat contain much gluten, making it a competitive material to produce gluten, for which global demand is high. The leftover starch biomass serves as a nutrient medium for a wide range of biotechnological products, one of which is bioethanol.

Basko Company has built a bioethanol factory called Production Complex Biokhim in North Kazakhstan oblast. The town of Stepnogorsk has both the production base and infrastructure, as well as a sound scientific and technological infrastructure to make bioethanol. This brings not only economic benefits to the country in terms of bioethanol as a biotechnology but also the strategic potential of biotechnology development as a whole.

Biotechnology and the environment

For Kazakhstan, environmental protection is of great i mportance.

The bulk of all investment goes to the oil and gas industry. Despite this, major oil extraction and processing regions such as Atyrau and Manghistau oblasts use old technologies and equipment, which cause environmental accidents and oil dumping.

Biotechnology can be used to address these issues. Phyto and bioremediation can be employed to remove heavy metals and other elements from the soil, through absorption of metals by plants, which is a cost-effective alternative to soil recovery methods such as excavation and rinsing.

Bioremediation has the following advantages: environmentally non-des-tructive, targeted use in the right place in the right time, high rate of microorganism decomposition of pollutants to environ-mentally safe bacteria, environmental and hygienic safety.

In terms of bioremediation developments in Kazakhstan, the National Biotechnology Center of the Republic of Kazakhstan is piloting field projects in Isatai rayon of Atyrau oblast to remove oil and oil products from the soil using microorganisms.

Production of biologically active supplements

The world faces the challenge of malnutrition characterized by lack of essential nutrients, which cannot be obtained by simply eating more. One of the solutions is to produce biologically active supplements enriched with polyvitamins, minerals and other important nutrients.

Reducing the proportion of people suffering from hunger and malnutrition is a serious challenge and is one of the Millennium Development Goals set forth at the Millennium Summit in September 2000.

Potential risks of biotechnological developments

New technologies, including biotechnology, have potential benefits for human life, sometimes much more significant than initially envisaged. At the same time, it should be remembered that such benefits may involve risks.

Ethical implications of biological and biomedical research have emerged and developed alongside the emergence and development of biology and medicine. Actually, two groups of ethical issues became apparent as soon as medical practitioners and biologists started to see their activity as an evidence-based intervention affecting natural human body in order to control, normalize and improve it. The first group relates to the right to conduct research on the (dead or living) human body, while the second relates to determining the morally acceptable limits for such interventions.

The Council of Europe's "Convention on the Protection of Human Rights and Dignity with Regard to the Application of Biology and Medicine: Convention on Human Rights and Biomedicine" (1996) defines a provision which is reflected in the respective laws of most European countries. The Convention's Article 28 runs: "Parties to this Convention shall see to it that the fundamental questions raised by the developments of biology and medicine are the subject of appropriate public discussion in the light, in particular, of relevant medical, social, economic, ethical and legal implications, and that their possible application is made the subject of appropriate consultation; similar arrangements should apply to the application of biomedicine". It is supposed that public accord attained through public debate and consultation will contribute to new developments in medicine. On this basis, the law grants or denies right to conduct medical R&D to scientists.

Also, there are such challenges as the creation and proliferation of biological weapons and human cloning. In this regard, an adequate and up-to-date legal framework should be carefully developed, adopted and implemented. Overall, biotechnological risks can be managed, for example, by ensuring complete biological safety in scientific and research laboratories working with disease-producing germs.

Currently, Kazakhstan is in a beneficial position because it is not pioneering biotechnological research and production. Rather, it follows developed countries, allowing it to learn from existing legal institutions required to manage potential risks. Recently, the National Biotechnology Center of the Republic of Kazakhstan has

Kazakhstan is in a beneficial position because it is not pioneering biotechnological research and production. Rather, it follows developed countries, allowing it to learn from existing legal institutions required to manage potential risks

Detailed research and comparison of expected benefits and potential risks are required, while well-equipped laboratories need to be set up and high-caliber specialists engaged to assure quality of products on the domestic market

developed a draft intersectoral Concept for biological and chemical safety of the Republic of Kazakhstan, which is currently under peer review with line ministries and departments.

Transgenesis, referring to the creation of transgenic plants and animals through genetic engineering, is another important area. This is further evidenced by the fact that in 10 years the area under commercial cultivation of genetically modified crops has grown by more than 50 times from 1.7 million hectares in 1996 to 90 million hectares in 2005. The number of countries extensively cultivating genetically modified crops increased from 6 in 1996 to 21 in 2005. Over the decade, genetically modified crops were cultivated on a total of 475 million hectares, which equals territory of such states as China or the USA and 20 times more than Great Britain[51] .

In order to avoid negative consequences and prevent the country from becoming a dumping or experimental ground, high quality services should be in place to oversee and monitor the use of foreign and domestic biotechnology products

At the same time, there is a concern that genetically modified organisms may have new qualities harmful for human beings, such as allergy, new toxic proteins and previously unknown protein combinations. In agriculture, new genes may be transplanted to other relative plants, thus changing their qualities. New varieties of plants may also have implications for animals.

Present day realities show that there is a need for research in genetic engineering. However, detailed research and comparison of expected benefits and potential risks are required, while well-equipped laboratories need to be set up and high-caliber specialists engaged to assure quality of products on the domestic market.

It should be remembered that in the context of growing global population, particularly in developing countries, production of foods with such qualities as high yield, drought and salinity resistance, etc. can become very important to ensure adequate food supply.

Biotechnology in Kazakhstan has an obsolete scientific and industrial base (of Soviet caliber), a limited corps of specialists, and lacks biotechnology innovation companies

Analysis of current and estimated needs allows identification of the most important niches in which to apply genetic engineering in agriculture. For example, genetically modified cotton seeds have been produced in climatic conditions similar to Kazakhstan. In the context of globalization Kazakhstan will be part of the global bioproduct market.

In order to avoid negative consequences and prevent the country from becoming a dumping or experimental ground, high quality services should be in place to oversee and monitor the use of foreign and domestic biotechnology products.

The current biotechnology context in Kazakhstan

Currently, the development and production of biotechnology products in Kazakhstan is inadequate. The range of biotechnology products is limited, while most of them cater for domestic needs because they cannot compete on the international market.

Unfortunately, over the last 15 years the range of research has narrowed, biotechnological research has shrunk and technologies have become obsolete. Today, biotechnology in Kazakhstan has an obsolete scientific and industrial base (of Soviet caliber) and a limited corps of specialists. The latter causes lack of competition resulting in low quality of scientific research. In turn, low quality of research does not encourage funding. This negative effect is aggravated by such factors as poor command of English language and lack of information and international cooperation.

Kazakhstan inherited the Soviet model of scientific progress and production characterized by slow response to the fast changing needs of innovative sectors and poor links between the needs and priorities of science and technology policy.

Unfortunately, there have been few developments that have been able to be really competitive on domestic or international markets. Another hindrance is the lack of biotechnology innovation companies. In this context, it should be remembered that private businesses are interested in fast profits, while, in contrast with returns in the extractive industry, biotechnology developments involve high economic risks.

Of many new developments, only a few are finally introduced, with even fewer being successful. The wide audience of consumers and businessmen remain unaware of products of the bioindustry and prospects for biotechnology development, which are, on the whole, only discussed in scientific and government circles.

Kazakhstan does not yet have the infrastructure and science capable of providing a basis for new biotechnology businesses. Where markets are small and it is difficult to raise funds from the private sector and international organizations, even with guaranteed protection of intellectual property rights, then the lead should be taken by government.

[51] *Detailed research and comparison of expected benefits and potential risks are required, while well-equipped laboratories need to be set up and high-caliber specialists engaged to assure quality of products on the domestic market*

Strategies to address the challenges and promote development of biotechnology in Kazakhstan

Biotechnology allows transformation of new knowledge generated through fundamental research, into capital, triggering the development of different economic sectors. Biotechnology-based approaches to setting up new or modernizing current production processes allows significant increases in returns on financial and other investment. It is through the latest biotechnology achievements that economic performance can become outstanding. In many cases biotechnology is more efficient and effective than traditional technologies. Priorities in biotechnology development in Kazakhstan should take into account the specifics and prospects of economic development, such as the great share of the agroindustrial and mining complexes and rich natural resources.

Also, it should be noted that in addition to the challenges described in the previous chapter, there are some positive aspects of the Soviet legacy in this field. The Soviet Union the second most significant player in the global microbiology industry and accounted for 3-5% of world biotechnology output. At that time, Kazakhstan was the production basis for the USSR's biotechnology, so that now, despite obsolete equipment and limited scope and quality of research, Kazakhstan still has basic capacity in the area.

Research can be of top quality only if local scientists integrate into the global scientific community. Integration should go alongside improving the quality of science and research, publications and infrastructures, as well as the provision of modern laboratory equipment. Quality and objective assessment of research are only possible if research complies with globally recognized standards.

In turn, such standards are determined by the standards of good laboratory practice. International standards of research should be introduced in Kazakhstan so that local scientists can promptly integrate into the common scientific space, while local research products will be understood and recognized on the global arena. The recognition of local research and development will allow publication of findings in leading scientific publications and will be an important step towards cooperation with international universities and research institutions that may be attracted to Kazakhstan alongside the international business sector.

The reality is that the goal of becoming one of the world's 50 most competitive countries cannot be achieved without the engagement of leading international scientists and specialists, as well as biotechnology companies to transfer modern knowledge and technologies. The development and introduction of new scientific products requires a developed science and research base and local cadre to ensure the creation of competitive industrial products. The building of human capacity and technological progress are therefore two mutually supportive and interdependent processes. Without adequate knowledge, scientists will not be able to develop and implement ideas, and without adequate equipment even qualified scientists will not be able to develop a competitive product.

The building of human capacity and technological progress are two mutually supportive and inter-dependent processes

In addition to engaging internationally recognized biotechnology experts, Kazakhstan should provide opportunities for overseas study for its specialists. Today, biotechnology training is provided for Bolashak bursary recipients to study at international educational establishments. In addition, the National Biotechnology Center has a number of international scientific projects underway with leading universities of the US, Japan and France. This includes laboratories with Kazakhstani employees, including former Kazakhstani citizens, who assist greatly with contact making, so that Kazakhstani biotechnologists can learn best practice overseas.

All of these measures are needed because biotechnology is a science-intensive sector, while rapid development and modernization requires continuous learning. Otherwise, both research and production organizations can lose their competitive advantages.

Technological progress has a cumulative effect, i.e. the gap between developed and developing countries is growing due to their differing levels of knowledge and technologies. Therefore, Kazakhstan should make every effort to not lag behind.

Below is a list of concrete recommendations to develop biotechnology in Kazakhstan:

- create an environment enabling the development of biotechnology companies and encourage investment

Box 5.3.1.

In 2006 Kazakhstan allocated some 3.5 million US dollars to biotechnology programs, which is 3 times more than in 2005. Currently, preparations are being made to build a new complex for a National Biotechnology Center of the Republic of Kazakhstan with an overall budget of USD50 million, to be completed by 2009. The Center will strive to become a competitive institution, complying with the highest international science and research standards and applying a new method of science and research management based on self-governance and self-sustainability, which are characteristics of the world's leading research institutions.

through an improved legal framework and provision of benefits and guarantees on the part of government;

- transfer of advanced technologies through leading biotechnology companies;
- create real links between research and development and their practical application through biotechnology divisions within technology parks;
- pursue integration in the common scientific space and improve the quality of research through introduction of international standards;
- gradually introduce international standards of research through support to and building of technological capacity of organizations which are making efforts to introduce international standards; create an enabling environment for international accreditation as an integral part of research projects undertaken by local scientific institutions and laboratories.

5.4. Social technologies

Based on the modes "person-to-machine" and "person-to-person", which were mentioned in section 1.1., technologies can be divided into industrial and social.

Industrial technologies are chains of precisely matching processes and operations, while social technologies refer to a specifically organized set of measures which contribute to one and the same goal and are used in different sequences and to different extents.

Therefore, when talking about technologies, both types should be equally employed.

Social technologies are of a higher level of organization, since they allow solutions to be found to major human challenges and concerns. Such technologies have a wide range of capabilities and can be cross-cutting, contributing to intersectoral links. Today social technologies allow optimum solutions to a number of challenges faced by each individual in production and private life.

The cross-cutting nature of social technologies can be seen at various levels such as:

At the personal level

- Describing personal management styles (a management style determined by characteristics of a person)
- Describing a style a person uses to carry out a task, etc.

At the level of communication

- Describing characteristics of personal communication in production (a business involving other people); optimizing interpersonal relations and developing a protocol for communication to achieve an expected result.
- Developing recommendations to optimize relations as well as regulations and protocols to harmonize interpersonal relations.

In management and business

- Optimizing personal performance of professional duties.
- Matching a person's management style to professional tasks.
- Optimizing management styles for managers (business or human resource management).
- Developing negotiation scenarios considering the specific characteristics of negotiators; developing a presentation style and form which considers the characteristics of the audience.
- Selecting and training coordinators, i.e. people capable of producing new information that can help develop a business or optimize an existing business.
- Building hierarchical systems of business management.

In society and management of social processes

- Building hierarchical systems for self-governance at the community, city, regional or national levels.
- Optimizing strategies for election campaigns.
- Optimizing the legal framework for human rights and economic development, as well as the structure and operation of the government system.
- Developing programs and scenarios to find optimal solutions to social, economic and political challenges at the community, city, regional or national levels.
- Developing a program to promote a country's industrial development.
- Developing an optimal strategy to govern both a native country and other countries to achieve goals[52].

[52] Shiyan A.A. Social technology manual./ http://www.i-u.ru/biblio/archive/shijan_rukovodstvo/default.aspx

In a modern society, social technologies are an important factor allowing intensification of social processes in the economy and politics, education and culture and addressing issues related to social security and protection, employment, etc.

Presently, Kazakhstan uses social technologies but fails to review their implications and impacts. In this regard, one of the priority tasks is to look at the scope of social technologies and their resulting impacts, as well as potential risks.

A modern market economy needs management technologies in order to rationalize communication and establish effective business contact, identify and realize business potential according to business development goals, social norms and standards. There is a need for new technologies in human resource management, national and municipal governance, environmental operations, property development, elaboration and implementation of programs targeting better quality of life and to help alleviate social tensions, as well as social technologies for businesses, etc.

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It is particularly important for Kazakhstan to ensure the innovation of technological development, since this is the only way to set up a modern technological base, produce competitive products and, eventually, to achieve sustainable social and economic development.

Social and economic development is impossible without a national strategy for technological development. In this regard, government support for research should be harmonized with the priorities of technological development.

One of the main implementation tools should be a comprehensive system to stimulate transfer of advanced foreign technologies, including direct financial support through grants, reduced credit, leasing, etc. and indirect support through tax and investment privileges. At the same time, the transfer of advanced technologies should be based on the needs of the economy and available resources and should consider technological constraints and ensure further development of scientific and technological capacity.

Social technologies are an important factor allowing intensification of social processes in the economy and politics, education and culture and addressing issues related to social security and protection, employment, etc

CHAPTER 6. NEW TECHNOLOGIES FOR THE BENEFIT OF KAZAKHSTAN'S PEOPLE

In the context of economic globalization, developed countries ensure economic growth by improving existing technologies and equipment and using new scientific achievement to ensure decent living standards.

As the national economy develops and regular income of the population grows, people have better access to the benefits of technological progress.

Today, Kazakhstan should develop a beneficial dialogue between science and the public.

If this issue is effectively addressed, scientific developments and new technologies will have better returns. In particular, this will create not only economic benefits but also enable the development of modern, highly efficient and competitive technologies meeting the needs of the people and building their social and political capacity.

The development of new technologies should lead to sustainable economic development and improved living standards through:

- job creation in science, production and services;
- improved educational level of the population and an increased proportion of people engaged in more qualified work (in different sectors) with better remuneration;
- tackling of production, environmental and social issues through new technologies;
- more research related to the production of consumer goods, medicine, etc., which helps to develop and introduce new products, medications, etc. In this way, the domestic market will have modern, efficient, competitive and, more importantly, affordable goods;
- more revenues to budgets of different levels through an increased volume of production of science-intensive products and increased income of the population;
- provision of new equipment, allowing improvements in the production process through a better working environment for service personnel and less environmental impact.

The relationship between technologies or new technologies and human development is obvious if such technologies are developed and used directly to meet existing and future needs and wants of people and society.

The development of new technologies should, firstly, meet the needs of the population, help address environmental issues and contribute to the development of medicine, pharmacy, mechanical engineering and instrument engineering, including environmental and scientific instruments, food industry, agriculture, information science, construction, etc.

The development of new technologies should, firstly, meet the needs of the population, help address environmental issues and contribute to the development of medicine, pharmacy, mechanical engineering and instrument engineering, including environmental and scientific instruments, food industry, agriculture, information science, construction, etc

Lack of financial support on the part of the government, a deficient legal framework and underdeveloped innovation infrastructure are the main factors currently hindering the process of innovation and relating, to a greater or lesser extent, to the government's activity.

To achieve the above goals, meet needs and remove barriers based on the human development implications of new technologies, the authors suggest a unified approach, which will promote long-term national development goals. With this approach, effective infrastructure will be created, technological development promoted, national science and technology policy developed, and public readiness ensured.

6.1. Infrastructure development

Without developed science and technology contributing to an innovative economy, no country can make economic progress, since human development and development of the human civilization determines science as a "primary development factor". Fundamental achievements in science and technology have been officially recognized as the basis for social development and welfare, because one monetary unit invested in R&D brings 9 units of GDP increase, in particular through the introduction of new technologies.

This indicates that new technologies allow old and new challenges to be tackled through new solutions, knowledge and technologies at lower cost. New technologies open up access to a wider circle of users and have a multiplier effect, which creates a positive environment for society.

Technological infrastructure should be developed and improved with a systematically operating subsystem to solve structural internal issues

Therefore, technological infrastructure should be developed and improved with a systematically operating subsystem to solve structural internal issues. This means that each constituent subsystem should be open to learning and improvement. In this context, the development and distribution of new technologies should target social development and protection from external factors.

To this end, the following measures should be undertaken:

on the part of scientific and academic community

- develop world-class R&D and new technologies in sectors essential for the national economy, social development and national welfare;
- educational institutions should be more internationally competitive by investing in better quality of education and research, more interdisciplinary research and engaging international level researchers;
- introduce new technologies in education in order to promote the scientific literacy of the population, from primary and secondary schools to higher education, etc.

on the part of the government

- develop and introduce a system of monitoring and analysis of factors currently hampering innovative activity, including assessment of the status and trends in small innovative business at the national, oblast, city and rayon levels, and of efficiency of the innovation process;
- create a common information space where connection, monitoring, navigation, transfer and processing of information, notification and management signals will be continuous, global, timely and accessible to ordinary users, in particular, to secondary, higher and vocational education, scientific and engineering organizations and businesses.

All parties involved in the innovation system and governmental agencies should recognize the need for new cooperative programs and projects to improve infrastructure and cooperation through cost-sharing, in order to develop and promote social and technological innovation based on universal research.

The development and improvement of technological infrastructure should accompany harmonization of interests of government, business, the scientific community and regular people

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The development and improvement of technological infrastructure should accompany harmonization of interests of government, business, the scientific community and regular people, all of whom should realize a shared goal, which is to achieve sustainable socio-economic development and ensure good living standards and human development.

To satisfy the interests of each group and establish partnership,

the government should

- create an environment that facilita-tes the emergence of small businesses offering knowledge-intensive services and ensures development and transfer of new knowledge and set up technology transfer centers within research institutions and higher education establishments through provision of start-up capital and reduced taxation and legal and information support;
- create infrastructure for transfer of technologies: regional and international networks of technology transfer, technology transfer offices based within universities and research institutions, exhibitions and fairs of innovative technologies and projects;
- train business personnel, firstly, for small technological businesses and innovative structures such as technology parks, innovation and technology centers and technology development centers in order to ensure effective management throughout the process of innovation;
- provide creative incentives and new forms of partnership, encourage co-operation between higher education establishments, scientific institutions and the private sector through tax benefits, subsidies, awards, grants, etc.
- set up venture funds, which will enable participants of the innovation system, i.e. scientists, researchers, institutions and representatives of the business sector to share risks through cost-sharing of R&D projects and programs.

Partnership between government, businesses and scientific community

Governmental and public research organizations and financial institutions should cooperate more, both with each other and with private, government and foreign funds to develop, promote and then expand initiatives and clusters of top standard.

Cooperation between government, science, civil society and business can be improved at each stage through well-informed decisions and information obtained through science-oriented research and use of new and old technologies as a tool to achieve short and long term targets of social and economic development.

To promote regional development, it is recommended to set up a number of innovative organizations in regions such as technology parks, innovation and technology centers, innovation and industrial complexes, science towns and national scientific centers. The status of national and governmental organizations will promote international prestige and thus attract more foreign investors. Such centers and technological innovation, including information and communication technologies, will help overcome physical distance, helping to gradually remove the gap between the center and regions and redistributing cultural life towards the regions through intensified information exchange.

6.2. Promoting technological development

National science and technology policy created through active research and development and use of top-class new technologies should help address the issues raised in this report. In particular, the creation of a national innovation system and enhancement of human development. To this end, there is a question of how well the existing legal framework can facilitate the development and implementation of measures to improve living standards and quality of life through new technologies. Up to now, national technological development has not been considered through the prism of human development, which explains why policy documents cannot fully address existing problems.

In terms of legislative measures, it would be advisable to develop legal control of the creation, transfer and protection of intellectual property and to create an enabling environment for those involved in the production and commercial use of scientific knowledge and technologies such as industries, small businesses, scientific and technological organizations, universities, incubators, technology parks and other organizations.

Such measures should contribute to:

- beneficial credit of the most promising scientific and technological works;
- insurance of investments in high risk science and technology;
- reduced taxation or tax holidays for individual science and technology projects;
- improved customs legislation pertaining to science and intellectual property;
- national infrastructure for the transfer of intellectual products.

We now look in more detail at different mechanisms of government contribution to an enabling innovation climate in the economy. Tentatively, there can be three components of government work in this sphere: creating special financial mechanisms of government support for innovation; developing innovation infrastructure; indirect control methods.

There are two key financial mechanisms by which government can contribution to an enabling innovation climate: funding through a system of government science and technology programs of different levels and through special funds.

Lack of R&D funding and equipment during the transition period resulted in the discontinuation of research in a number of areas where Kazakhstani scientists had a competitive advantage.

The national budget, through special programs, should fund:

- socially important R&D (for example, the bulk of medical R&D);
- priority goals of national development;
- development of new technologies that are important for social development and the state, but unattractive for other market entities;
- development of socially important infrastructure (creation of a network of small business incubators, innovation and technology centers);
- grant programs to fund commercial projects in order to stimulate the development of small high-tech businesses (as a rule, involving co-funding from the private sector).

In turn, out of "forward-looking" programs, funding should be provided according to global trends. For example, funding should be channeled into such areas as national security and national economic entities, considering the risks associated with the introduction of new technologies.

In addition to government funding, there should be other sources, both national and international, and a system of off-budget sectoral and inter-sectoral funds to finance R&D through innovative programs and projects.

In addition to government funding, there should be other sources, both national and international

The tax system is a key component of indirect control. Taxation should be neutral or stimulatory to encourage businesses to gain and, more importantly, not hide profit, which investors see as a key performance criterion. Strategic investors see such characteristics of the tax system as the tax base and tax rates rather than a variety of tax privileges and benefits as key.

In the context of economic reforms, national scientific capacity has shrunk. This hampers national competitiveness on global markets of science-intensive products and services and prevents the introduction of technologies.

In order to change and improve the situation the following should be considered:

From the perspective of government control

- continue active negotiation on WTO accession, harmonize national legislation with WTO rules and regulations and other related international structures and standards (ISO, WIPO, ILO, etc.);

- the government should pay more attention to internationalization of education, research and innovation as a primary goal of overall development of the science, research and innovation system. International relations should be improved, while there should be legislative measures to promote internationalization in order to attract the best international researchers and experts;

- stimulate investment in science and technology through an enabling environment both for national and international investors;

- set up a system of government and private insurance (at least partial), investment in innovation, provide support to insurance companies taking credit risks arising from the use of innovative products;

- support and encourage investors in science-intensive high-tech production and organizations of different ownership types when they are in the process of innovation. This may be through guaranteed collateral reserves under real assets such as highly liquid and financial assets of the government, for example share holding, and through subsidizing a part of interest rates for commercial banks' credits;

- put in place economic incentives for businesses to contribute to the implementation of the Strategy of Industrial and Innovative Development of the Republic of Kazakhstan for 2003-2015 as well as national, regional and sectoral programs and government procurement;

- stimulate the establishment of small businesses engaged in development and transfer of new technologies and technology transfer centers in research institutions and higher education establishments through, for example, provision of startup capital and reduced taxation and legal and information support;

- develop a comprehensive system of legal protection, including exercise and distribution of rights to intellectual property;

On the part of ministries and the scientific community

- national programs for the development of all sectors of science and technology should include human development elements such as training, prevention of technological risks and alleviating innovation and age divides and regional and gender disparities;

- develop effective methods to overcome major risks arising from the use of new technologies. National scientific and technological assessment should be intensified, while all science and technology programs developed and implemented in Kazakhstan, including imported technologies, should be reviewed by a group of local and international experts in order to minimize risks. The assessment should embrace qualitative characteristics, compliance with national standards, environmental, technological and social safety. To improve assessment procedures, the assessment methodology and principles should be continuously reviewed;

- technologies should be introduced on a pilot basis to identify test models. With any uncertainty and lack of evidence that new technologies do not involve social or environmental risks, precautionary measures should be taken as not to use such technologies. In addition, if a technology affects project or institutional management style or methods, additional information should be provided before it is introduced to ensure efficiency and manageability. This might include additional measures of quality of products and processes, project performance indicators and methods of risk alleviation;

Partnership between the private business and scientific communities

It is important to bear in mind that innovation is a complex non-linear process embracing a set of actions to create the end product through cooperation between government, the general public, scientific community, institutions, technological centers, consulting companies, enterprises, etc. Each partnership and product effectiveness is based, first of all, on the capacities of all parties involved. Thus, in order to stimulate innovation processes, coherent actions should be taken to support all parties of the process and active areas of technological progress. Also, action should be taken to identify, monitor and analyze the needs of civil society to take pro-active measures for the public benefit and to meet all current needs.

In order to ensure links between R&D and production, the needs of the population and industrial enterprises should be identified in terms of fundamental research, technological and engineering development and production of machinery and equipment, so that these needs can be met by the mechanical engineering sector and national science and research organizations, through bidding. Also, a system of monitoring and review of factors hampering innovation should be developed and introduced. This should include an assessment of the current and future status of small innovative businesses at the national and regional levels and performance of the innovation process.

6.3. Developing integrated national policy

Government has a complex responsibility for developing and implementing integrated national science and technology policy within the framework of identified priorities and breakthrough areas in the interest of social and economic development, as well as coordination of the interests of government, private businesses and management and staff of scientific organizations.

Today, government support for science and technology in Kazakhstan is of central importance. Reforming and enhancing the role of national science and technology in national economic development through breakthroughs in priority areas should be prioritized.

When developing new technologies, the government should focus on creating an environment enabling the complementary existence of two processes – human development and technological progress. It is also necessary to facilitate sustainable economic development based on effective use of intellectual capacity, employment of highly qualified personnel and the generation, transfer and application of new knowledge.

When developing integrated policy, government action should promote human development through new technologies contributing to:

- improved health of the population;
- better environmental management;
- better access to and quality of healthcare;
- improved access to high quality education for all groups of the population;
- meeting the needs of the economy for professional cadres with special qualifications;
- an environment enabling social and personal development, etc.

Kazakhstan's long-term goals should be sustainable and balanced social and economic development, including such key factors as good employment, productivity and competitiveness.

It is important that Kazakhstani society comes to realize that science gives birth to knowledge and information that can be used to effectively manage resources such as natural, production and human resources to create an enabling environment for people through new technologies. Poorly justified new technologies based on R&D can have detrimental human implications such as manmade disasters, ineffective use and exhaustion of non-renewable natural resources and environmental impacts, as well as damage to everything that is vital for the future generations.

In this regard, significant contributions should be made to:

- enhance the role of science, technology and innovation policy;
- reform the national sector of science and technology to enhance the competitiveness of national science and technology and promote its role in national economic development through breakthroughs in priority areas of science, technology and equipment;
- regional and global institutional support, to ensure equal and fair rules and strategies building technological capacity;
- in cooperation with national and international scientific communities, identify an optimal policy balance between two fundamentally differing systems of innovative development: transfer of new foreign technologies and support to science-intensive technologies developed by national scientists through development institutions.

When developing new technologies, the government should focus on creating an environment enabling the complementary existence of two processes — human development and technological progress

6.4. Ensuring social readiness

An important factor in social development is access to all technological commodities and advocating the interests of a wide range of groups. The government should provide every support for people to acquire knowledge, have access to technological innovation and learn how to use it. Such support should facilitate materialization of ambitious wants, opportunities and needs of each person, in particular, life expectancy, highquality healthcare, good education and employment and high income.

When ensuring public receptiveness, in addition to the above criteria, the social and cultural environment should be prepared and made receptive to the development, introduction and use of technologies. For innovations involving not only advanced consumption forms but also generation of new ideas, in order for them to develop further, Kazakhstan should promote a positive public attitude to the process, i.e. shape mentality. As a rule, innovation does not involve the entire population. However, innovation is impossible if the population views it as an unaffordable luxury, a hostile intrusion or an impingement on traditional values.

An important factor in social development is access to all technological commodities and advocating the interests of a wide range of groups

To this end, it is recommended to promote public:

- recognition of the importance of education and continuous learning;
- understanding of the inevitability and importance of technological progress for the benefit of human development;
- recognition of the importance of comprehensive reviewing of the implications and risks of introduction and use of technologies;
- confidence and belief in the importance of national R&D;
- readiness to take well thought-through risks to make profit.

It will be impossible to promote public receptiveness and readiness without a system of high-quality training of high-tech specialists and education

It will be impossible to promote public receptiveness and readiness without a system of high-quality training of high-tech specialists and education.

A multi-level system of training requires the following:

- funding of staff training using internal development resources, such as government funding; funds of regional authorities interested in staff training of corporations and innovation centers; performance of research works and tuition fees; and resources provided by international organizations, funds and technical assistance programs;
- introduction of new educational technologies promoting better rural literacy through organization and control over all elements of schooling, such as out-of-class work, scientific activity by teachers and students, introduction of new technologies in the learning process and competitive selection of teaching staff;
- training of qualified trainers and consultants for educational establishments specializing in staff training and consulting services for innovative enterprises;
- training of scientists, primarily authors and designers, specialists of scientific divisions and managers of scientific establishments in principles of technology commercialization and use of research and science outcomes as an innovative resource;
- training and professional learning for central and regional authorities and municipalities responsible for innovation, commercialization of technologies and management of related markets;
- development of a concrete and targeted program for advanced learning, training and staff attestation and certification at all levels of education, science, technology and innovation, engaging national and international experts;
- IT training for older staff and advanced professional training for experienced staff to alleviate the technology divide and prevent unemployment among the older generation;
- development of a social package to promote the prestige of the scientific, engineering and pedagogic professions and improve their social status and income level.

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All of these issues are relevant for Kazakhstan, since there is growing interest in the use of new technologies in different areas. Targeted work of the government, the general public and the private sector to stimulate the development and introduction of technologies will be a mechanism to ensure the widest possible access to technological commodities.

Comprehensive activities and programs will help address most of the issues raised in this Report and set up a national innovation system enabling the development of new technologies and making Kazakhstan one of the leading competitive countries in the world. For this to happen, all responsible ministries and related agencies should work together and realize that each program, first of all, should complement all previous programs and should then set new targets. As a result, technologies will also enable Kazakhstan's integration in global cultural processes. In addition, new technologies have a growing creative capacity to enable a variety of effective forms and methods of individual creation, self-fulfillment and group work in order to solve shared problems and advance cultural and social development.

CONCLUSION

The National Report "New Technologies for Human Development in Kazakhstan" seeks to draw public attention to the goals and challenges of technological development, which is viewed as a factor promoting economic growth in Kazakhstan. This is due to the fact current economic growth is attributed largely to the development of the extractive industries with low value added.

Not only is Kazakhstan rich in natural resources but also in highly qualified human resources, which can be the basis for technological development as a human development tool. However, not all technologies can be used as human development instruments because of culture, mentality, existing infrastructure, etc. Therefore, the authors put forward a selective approach to using technologies.

To balance technological and human development, Kazakhstan needs to:

1. have a selective approach to the selection and use of new technologies from a human development perspective;

2. elaborate, in the framework of the long-term development strategy Kazakhstan 2030, new programs taking account of the current context and new aspects of human development in Kazakhstan;

3. incorporate sustainable human development targets into the goal of becoming one of the world's 50 most competitive nations;

4. ensure continuous national competitiveness and sustainable human development through Kazakhstan's integration in the global economy;

5. address the health targets of the Millennium Declaration relating to reduced child and maternal mortality, halting the spread of HIV/AIDS and other diseases;

6. effectively manage its huge natural resources by conserving nonrenewable resources and enabling sustainable human development of future generations through renewable resources;

7. achieve a number of targets related to professional government and decentralization and continue anticorruption efforts;

8. along with the introduction of a new system of vocational and higher education, improve the quality of education towards Soviet period standards, based on the needs of both the economy and human development;

9. identify areas of fundamental and applied science capable of providing Kazakhstan a competitive advantage through the global marketing of local ideas and technologies, and ensure adequate funding of science;

10. increase state expenditure on research and development in these areas and encourage increased costsharing from the private sector, which should result in growing global exports of products and services of new and advanced technologies;

11. promote the acquisition of knowledge translating into new technologies for human development;

12. ensure that technological development is innovation-based, since this is the only way a new and modern technological base can be established, allowing competitive production and the achievement of sustainable social and economic development.

An enabling context for the above has already been partially created in Kazakhstan. For example, the following policy documents have been adopted: Strategy for Industrial and Innovative Development of Kazakhstan for 2003-2015 (in 2003), the Program for Development of the National Innovation System of the Republic of Kazakhstan for 2005-2015 (in 2005), the State Program for Development of Science up to 2012 (2006) and the State Program for Development of Education up to 2010 (in 2005). These documents aim to establish an innovative economy.

All the recommendations listed above emphasize the links between the work of government, the scientific community and business and Science and Technology, since such cooperation can be rationalized at each stage through informed decisions, findings of scientific research and outcomes of the use of (new) technologies as a tool to achieve the social and economic development targets.

Therefore, this National Human Development Report seeks to draw public attention to the challenges related to the development, adaptation and introduction of new technologies. To maximize the benefit, all stakeholders, namely government, the general public, scientific community and businesses, should be extensively involved in the process.

Through the Report, the authors have attempted to show that although indirect, there is a link between technologies and human development and that the development of new technologies will not necessarily lead to an increased level of human development.

The major conclusion is that the ultimate goal of technological development is to use technologies to make human life more comfortable and improve human welfare, rather than to simply promote overall economic development. And, secondly, from the human development perspective, technologies that are critical for Kazakhstan's human, economic and sustainable development should be identified.

GLOSSARY

Applied research Original research undertaken to acquire knowledge and obtain concrete practical results.

Bioethics The Systemic study of moral values and principles in human activities related to biology and medicine.

Biotechnology Application of the principles of engineering and technology to the application of biological agents such as microorganisms, cell cultures, cell or organism parts on materials.

Bretton Woods Institutions (BWIs) were established at Bretton Woods, New Hampshire, in July 1944 when delegates from 45 nations gathered to set up a new international financial system to finance the reconstruction of war-torn Europe and Asia and the prevention of economic decline. The mission of the BWIs was formulated as support to global development, democracy and peace. Today the Bretton Woods Institutions, also known as the World Bank Group, are five inter-connected organizations, which are the International Monetary Fund (IMF), the International Bank for Reconstruction and Development (IBRD), the International Development Association (IDA), the International Finance Corporation (IFC), the Multilateral Investment Guarantee Agency (MIGA), and the International Centre for Settlement of Investment Disputes (ICSID). The World Bank Group provides expert and financial support to improve living standards and reduce poverty in developing countries.

Business angel A private investor investing some of his/her own financial assets, as well as time and expertise, in ventures at seed and start-up stages or when additional investment can help prompt business expansion. Business angels are primarily former/current business people or hired managers with capital and expertise sufficient for informed investment and resulting venture management.

Business angel community An organization whose mission is to support entrepreneurs in need of private risk capital and business angels in search of one another. Communities tend to stay neutral on the evaluation of projects, except for formal initial selection, and stay aside from decision making, focusing on securing a spot for and providing professional support to both players of the investment process.

Circulation of innovation The process of market circulation of a new product. Once introduced, an innovation is circulated for an uncertain period of time, impacting the sales of this product.

Cluster A special network of companies (enterprises), academic institutions (universities, research institutes), support organizations (consulting companies) and users linked to a single chain for the sake of mutual benefit.

Competitiveness Refers to national capacity to expand presence on domestic and global markets. Determined by industrial capacity for on-going development, innovation and competitiveness.

Digital divide (rarely "digital inequality") "digital gap", "social digital inequality", "digital lag" A divide between countries or groups of population in their access to the Internet, other information products and communications. In particular, countries and groups have different access to high-quality information products and different opportunities to use them because of different levels of education and development of technical skills. This issue is often analyzed in an international context because some countries are better equipped, have greater opportunities to use information and communication technologies and have greater benefits from such technologies than developing countries. Overall, a digital divide is considered both as an effect and cause of economic underdevelopment.

Economic growth An increase in actual national output of goods and services over a certain period. To capture the improvement in the living standard, it is measured by growth rate of the Gross Domestic Product (GDP) over a specified period or in per capita terms in order to reflect its impact on living standards.

Evaluation of research Appraisal of effectiveness of research and development funded from the national budget or other sources, to improve the distribution, structure and funding of research, etc.

Innovation Refers to new ideas, methods and devices as well as production of new products and technologies including management and marketing strategies. Most commonly used to describe a change in technologies, individual processes, management or finance and means of facilitating such change.

Intellectual capital Intangible assets; the totality of intellectual assets including intellectual property, natural or acquired skills and knowledge. Intellectual capital integrates human capital, intellectual property, infrastructural and market assets.

Intellectual property Conventional collective terms. Includes rights to literary, artistic and scientific works, performances, recordings, radio and TV programmes (including copyright), discoveries, inventions and other rights related to different types of industrial property and protection from unfair competition.

Introduction Adaptation of innovation to the current environment, practical use of advanced ideas, inventions and research findings (innovation). Introduction of innovation requires the re-construction of production, re-training of staff and investment, and involves the risk of failure and loss.

Investment preference Granting of the right to additional deduction from total annual revenue of taxpayers investing in fixed assets to set up new or expand and develop current productions and exempt such taxpayers from property tax on fixed assets, set in operation through an investment scheme to set up new or expand current production.

Leasing (financial rent) A form of credit when the lessor must purchase property specified by the lessee from a specified seller and give it to the lessor for temporary possession and use for an income-generating purpose, in return for payment.

Management stages Monitoring, information management, financial management, human resource management, resource planning and allocation.

Nanotechnology A field of applied science and technology studying characteristics of objects and developing devices of nanometer size, which is 10-9 of a meter according, to the SI System. Nanotechnologies differ significantly from traditional engineering disciplines, since on such a small scale traditional macroscopic technologies of material handling are often useless, while microscopic phenomenon, weak on traditional scales, become more significant (qualities and links between individual atoms and molecules, quantum effect). Because of its use of advanced research findings, nanotechnology is a high technology.

National innovation system The complex of economic entities communicating to create and introduce innovative products and services, whose innovative activities are guided by a respective legal framework based on national policy. A national innovation system is developed to make qualitative changes to socially oriented areas such as industry, health, education, housing and construction, information and communication.

Pilot development Systemic activity based on knowledge obtained through research and/or empirically to create new materials, products, processes, devices, services, systems or techniques and further improve them.

Pilot research An integral part of "fundamental research", i.e. pilot projects to obtain new knowledge (see "Fundamental research").

Product innovation Innovation related to production and use of new or improved products.

Production stages Product development, consumer relations, consumer needs identification, production, maintenance, account management, after-sales service.

Risk In a wider sense means the potential emergence of circumstances determining:
- uncertainty or inability to achieve expected outcomes;
- material damage;
- currency loss, etc.

In a narrow sense, risk is measurable potential of loss or forgone benefits.

Social capital Refers to interpersonal relations through which resources or information about such resources is channeled. A network determines access to goods and information through appropriate channels.

Social technologies Technologies used in social relations, i.e. man-to-man rather than man-to-machine or man-to-nature relations.

State innovation policy Development and improvement of a legal framework facilitating economic introduction of intellectual products; economic policy in relation to innovative players; creation of innovative infrastructure to develop and enhance innovative business; governmental support for the commercialization of intellectual products, preparation of production and marketing of innovative products and services.

Technological commercialization Commercialization of research and development describes more extensive commercial use of products of completed research and development activity.

Technological innovation Innovation related to the creation and application of new or improved technologies.

Technology *(derived from the Greek word "téchnē" meaning art, technique, skill). In a wide sense, technology means knowledge that can be used to produce goods and services out of economic resources.*

In a narrow sense, technology means a substance, energy or information conversion technique in the process of production, material (re)processing, installation of products, quality control and management. Technology includes methods, techniques, regime, consequence of operations and procedures. It is closely linked to the tools, equipment, instruments and materials used.

Venture capital (risk capital) Long-term investment in securities or enterprises with high or relatively high risk of loss, in which the potential for profit may be considerable.

Venture enterprise (venture firm; risk firm) A relatively small business enterprise carrying out research and development, planning and design, and technological innovation of uncertain profit. There can be internal ventures, which are small innovation firms segre gated from corporations to create and introduce innovations, and external ventures, referring to small independent innovation firms aggregating to large corporations through provision of funding, consultation, pilots, etc.

ANNEXES
ANNEX 1. TECHNICAL NOTES

1. Integral human development indicators

In 1987 the UN Development Planning Committee decided to review the human cost of structural changes as a topic for its report for 1988. The findings of surveys conducted as part of a report by a group of experts headed by *Mahbub ul Haq* were part of a draft report "Human development: the forgotten measurement of development strategy" by *Kate Griffin.* Later, Griffin, in cooperation with *John Knight* published their works in a special edition of the Journal of Development Planning[53] in 1989 and re-published them as a book in 1990[54] . This served as the foundation for a conceptual approach to human development.

Theories by *Amartya Sen,* the Nobel prize winner in economics, who published his "Development as Capability Expansion"[55] in 1989 had a powerful impact on the contemporary concept of human development. Sen did not consider development as improving financial or economic welfare, but rather as expansion of human "capabilities", i.e. ability to live a long and healthy life, have access to knowledge, be able to be more active, etc. At the same time, increased capability was associated with greater choices. Thus, the human development concept identified human development and greater choices rather than greater GNP as an economic development target.

The conceptual approach to human development (also translated as *development of human potential*) elaborated by a group of UNDP experts was first published in the first Global *Human Development Report 1990*[56] where human development was defined as "expansion of human choices and achieved welfare". Income is only one of such choices. Equally important are health, education, environment and freedom of action and speech. The report provided a new tool to measure socio-economic progress: the human development index (HDI) which combines life expectancy, adult level of education and income.

This definition of human development pre-determines a wide and complex set of statistical indicators allowing assessment and review of human development. All statistical indicators capturing human development may be grouped as follows:

1. Integral indicators of general assessment of human development.
2. Basic indicators capturing the main components of integral assessment of human development.
3. Other indicators capturing other dimensions of human development.

2. Basic and integral human development indicators

Basic human development indicators capture three main dimensions of human development, which are *longevity, education and living standards.* Each of these human development dimensions captures a number of important human capabilities. Thus, longevity means capability to live a long and healthy life, education – to acquire knowledge, communicate and participate in public life, living standards – to have access to resources required for a decent living, live a healthy life, be territorially and socially mobile, participate in public life, etc.

A set of indicators calculated on a regular basis and comparable across nearly all countries of the world is used to measure these three human development components. An increase in the value of basic indicators suggests better capabilities in the respective human development dimension.

Indicators capturing longevity. *Live expectancy at birth* is used to measure **longevity.** A shorter term is often used – life expectancy. It is one of the most common indicators in international statistics, which is calculated based on so-called "mortality rates".

Life expectancy at birth – the number of years a newborn would live, provided death rates for each age remain the same as in the birth year throughout the entire life of the newborn.

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[53] *Griffin K. and Knight J. (eds). 1989. "Human Development in the 1980s and Beyond." In: Journal of Development Planning. No. 19 (Special edition).*
[54] *Griffin K. and Knight J. (eds). 1990. "Human Development and the International Development Strategy for the 1990s". London: Macmillan.*
[55] *Sen A. 1989. "Development as Capability Expansion." In: Journal of Development Planning. No.19.*
[56] *UNDP. 1990. Human Development Report 1990. New York: Oxford University Press.*

These indicators can be both gender-aggregated and gender-disaggregated.

In addition, *proportions of the population not surviving to a certain age* are used to calculate the human poverty indices and to capture deprivation in the ability to live a long and healthy life.

The *under-five mortality rate* and *maternal mortality rate* are additionally used for developing and developed countries respectively.

Indicators capturing education

Education is measured by the literacy rate among the 15+ population and the enrolment ratio.

Literacy is the ability to both read and write, with understanding, a short statement related to the person's everyday life.

For developing countries, literacy is the most significant indicator of education. Therefore, it is given twice the weighting as the enrolment ratio when calculating the HDI.

Global Human Development Reports before 1995 used, instead of the enrolment ratio, *average duration of learning* calculated for the population aged 25 and more. Since the 1995 Report, however, this indicator was replaced by the enrolment ratio.

The enrolment ratio is the number of students enrolled in primary, secondary and tertiary levels of education, as a percentage of the population aged 5-24.

It should be remembered that different levels of education impact human capabilities differently. Therefore, Anand and Sen suggested complementing the common education indicators with those specific for individual levels of education, so as to use enrolment in secondary and tertiary education for developing and developed countries respectively.

Indicators capturing living standards

Unlike the previous two dimensions, *this human development dimension only identifies human capabilities* rather than determining their use. This means that it is only a means of enlarging the capability to choose but not the choice as such.

The high-quality assessment of the living standards should include many factors determining development and fulfillment of human capabilities, such as personal income, income distribution between different population groups, accrued property, access to land and credit resources, infrastructure and access to public commodities such as healthcare, education, transport, utilities, etc., individual lifestyles, family size and composition, commodities produced by households, environmental and climatic conditions etc.

Since it is difficult to select a *direct* indicator, an i*ndirect* indicator - *Gross Domestic Product (GDP) per capita* – is used to assess financial welfare. For inter-country comparisons, GDP per capita should be converted into real GDP per capita in USD using purchasing parity power (PPP) of national currency relative to US dollars.

PPP is understood to be the number of national currency units required to purchase an identical basket of goods and services that can be bought for US$1 in the USA.

Countries comprising different groups depending on their level of economic development can be compared using complementary indicators, allowing to more objectively differentiate countries within one group depending on their financial welfare. Thus, for the least developed countries *real GDP per capita* is a relatively adequate tool to capture access to resources required for a decent living. For developing countries, it makes sense to complement it with the *proportion of people with income below the poverty line,* which captures poverty incidence, which is more common for the less developed countries. For developed countries, these two indicators should be complemented with i*ncome inequality indicator*[57] *:*

$$Y = (1 - G) \times Y^r,$$

where G Gini coefficient;

Y^r real GDP per capita.

When countries have the same real GDP per capita, the Gini coefficient allows differentiation of countries by living standards.

3. The Human Development Index (HDI)

The Human Development Index is calculated as an arithmetic average value of three other indices: life expectancy, education and GDP. The education index is calculated using the indices of literacy (two thirds weighting) and access to education (one third).

Four indicators are used to calculate these indices. The accepted ranges of these indicators lie within the following limits:

Indicator	Minimum value	Maximum value
Life expectancy at birth, years	25	85
Adult literacy rate, %	0	100
Combined gross enrolment ratio, %	0	100
GDP per capita, PPP USD	100	40000

Based on these indicators, the following formula is used to calculate all indices apart from the GDP index:

$$I = \frac{\text{actual value of } x_i - \text{minimum value of } x_i}{\text{maximum value of } x_i - \text{minimum value of } x_i}$$

When building the GDP index, a different formula is used. The formula uses a decimal logarithm of GDP per capita in numerator and denominator:

$$I = \frac{\log_{10}(\text{actual value of } x_i) - \log_{10}(\text{minimum value of } x_i)}{\log_{10}(\text{maximum value of } x_i) - \log_{10}(\text{minimum value of } x_i)}$$

Kazakhstan, which had the following main indicators in 2005, can be used to illustrate the calculation of the human development index:

Indicator	Value
Life expectancy at birth, years	65.9
Adult literacy rate, %	99.5
Combined gross enrolment ratio, %	85
GDP per capita, PPP USD	8068

Hence, according to the above formula, the life expectancy index will be 0.682:

$$(65.9 - 25) / (85 - 25) = 40.9 / 60 = 0.682.$$

The adult literacy index will be 0.995:

$$(99.5 - 0) / (100 - 0) = 0.995.$$

The overall education index will be 0.943, when the enrolment ratio is used worth 85%:

$$(0.995 * 2 + 0.850) / 3 = 0.947.$$

If calculated by the above formula the GDP index will be:

$$(\log(8068)-\log(100)) / (\log(40000) - \log(100)) =$$
$$= (8.996-4.605) / (10.597-4.605) = 4.391/5.991 = 0.733$$

The human development index based on these three indices will be 0.787:

$$(0.682 + 0.947 + 0.733) / 3 = 0.787.$$

4. The Gender-related Development Index (GDI)

The gender-related development index uses the same indicators as the HDI. They differ in that for GDI average values of each country's indices (life expectancy, education and GDP) are adjusted by the gap between male and female attainment. In order to make this adjustment, a weighting formula is used. This formula is based on the quality of the average power function to depend on the exponent of the mean *(majority median rule)*.

S. Anand and A. Sen suggested the following formula to calculate gender-adjusted indices [58]:

[58] *Anand S., Sen A. Human Development Index: Methodology and Measurement // Background Paper for Human Development Report 1993. - New York: UNDP, 1992.*

$$I = [d_f \times I_f^{1-\varepsilon} + d_m \times I_m^{1-\varepsilon}]^{1/(1-\varepsilon)},$$

where df and dm are, respectively, proportions of women and men in the overall population;

I_f and I_m are indices relative for women and men;

(1-ε) is the exponent of the average.

When different values of ε (exponent of the 1-ε mean) are used, different types of median emerge:

ε = 0 – arithmetic median;

ε = 1 – geometric median;

ε = 2 – harmonic median, etc.

The more the accepted exponent differs from the exponent of arithmetic median, the more significantly this affects the reduction of the average indicator. All Global Human Development Reports use the parameter of weighting ε fixed at 2 ("moderate deviation toward inequality"). The result is a harmonious middling of indicators of female and male attainment.

The GDI is also corrected in terms of maximum and minimum life expectancies considering that women generally live longer than men. Thus, maximum female life expectancy is fixed at 87.5 years and minimum at 27.5 years, for males 82.5 and 22.5 years respectively.

The equally-distributed life expectancy index (using the parameter of weighting ε = 2) is calculated by the formula:

$$I = \left(\frac{d_f}{I_{fle}} + \frac{d_m}{I_{mle}} \right)^{-1}$$

where d_f and d_m are, respectively, proportions of women and men in the overall population;

I_{fle} and I_{mle} are female and male life expectancy indices.

The equally-distributed education and income indices are calculated similarly. The summary human development index adjusted for gender is an arithmetic mean of the three equally distributed indices.

Calculation of an income index adjusted for gender is more complicated. It is expected that incomes generated in the country are distributed between men and women in proportion to their wages. Two types of data are used when the proportion of women and men with earned income are calculated: ratio of average wages of women to average wages of men and percentages of women and men in the economically active population aged 15 and older. When data about the ratio of average wages of women and men are not available, a weighted mean ratio of 75% for all countries that have data on wages is used.

The proportion of wages for females (S_f) is calculated by the formula:

$$S_f = d_{eaf} \times I_{isf} / (d_{eaf} \times I_{isf} + d_{eam}).$$

where d_{eaf} and d_{eam} are the proportions of women and men in the total economically active population;

I_{isf} is the index of the average female wages relative to average male wages.

Taking into account the age and gender composition of the population we can calculate incomes (GDP) per one woman and one man:

$$GDP_f = GDP \times S_f / d_f,$$
$$GDP_m = GDP \times (1-S_f) / d_m,$$

where GDP, GDP_f, GDP_m are GDP per capita, per one woman and one man.

5. The Gender Empowerment Measure (GEM)

The gender empowerment measure (GEM) is built on indicators calculated specifically to measure the relative political and economic participation of women and men.

The first two indicators are used to capture economic participation and decision-making power through women's and men's percentages of positions as senior officials and managers and women's and men's percentages of professional and technical positions. Since the proportions of positions of each of these categories are different in the overall population, indices are calculated individually for each category and then summed.

The third indicator, which is women's and men's percentages of parliamentary seats, has been selected to capture political participation and decision-making power.

For each of these three dimensions, an equally distributed equivalent percentage (EDEP) is calculated, as a population-weighted average, according to the following general formula:

$$EDEP = \left(\frac{d_f}{d_{fi}} + \frac{d_m}{d_{mi}} \right)^{-1}$$

where d_f and d_m are, respectively, female and male population shares;

d_{fi} and d_{mi} are, respectively, earned incomes of women and men by each of the three indicators.

Then these indicators are indexed by dividing the EDEP by 50 %.

The income index is used as an indicator capturing the ability to manage economic resources. This index is calculated using the GDI methodology. The income index can be PPP US$40,000 maximum and PPP US$10,000.

Finally, equally weighted indices for each of these dimensions - economic participation and decision-making power, political participation and decision-making power and the ability to manage economic resources – give the combined GEM.

6. The Human Poverty Index (HPI)

Depending on the socio-economic conditions of individual countries, different indicators can be included in the Human Poverty Index (HPI). In the Global Human Development Report for 1997 the Human Poverty Index suggested for developing countries (HPI-1) reflects all three dimensions of human life that are included in the HDI – namely a long and healthy life, knowledge and a decent standard of living:

$$HPI\text{-}1 = [1/3(P_1^3 + P_2^3 + P_3^3)]^{1/3}$$

where P_1 - percentage of population not surviving to age 40,

P_2 - adult literacy rate,

P_3 - average of population without sustainable access to safe water and healthcare and under-five children underweight for their age.

Considering the completely different social and economic conditions in developed industrial countries, UNDP in its Global Human Development Report 1999, suggested a different formula to measure poverty (HPI-2) of the populations in these countries:

$$HPI\text{-}2 = [1/4(P_1^3 + P_2^3 + P_3^3 + P_4^3)]^{1/3},$$

where P_1 - percentage of population not surviving to age 60,

P_2 - percentage of adults lacking functional literacy skills,

P_3 - percentage of population with income below 50% of median adjusted income in the country, i.e. income in the middle of the income distribution line,

P_4 - percentage of the economically active population unemployed for 12 months or more.

The following formula for calculation of HPI has been adopted (as of National Human Development Report 1999) for Kazakhstan:

$$HPI = [1/4(P_1^3 + P_2^3 + P_3^3 + P_4^3)]^{1/3},$$

where P_1 - percentage of population not surviving to age 60,

P_2 - percentage of young people aged 16 not enrolled in schooling,

P_3 - percentage of population with income below the subsistence minimum,

P_4 - unemployment rate.

Illustrating using calculation of Kazakhstan's HPI for 2005. The baseline data are $P_1 = 30.7\%$, $P_2 = 1.1\%$, $P_3 = 9.8\%$, $P_4 = 8.1\%$.

Using the above formula, Kazakhstan's HPI for 2005 will be 19.7%, which suggests that about one fifth of the country's population is disadvantaged (deprived in terms of human development) by the selected four indicators.

ыThe human development index can be improved if disaggregated. The overall index of a country can mask the fact that different groups of the country's population may have different levels of human development whether by region, gender or settlement (urban or rural).

When calculating regional HDI, the main problem is the choice of an indicator most adequately reflecting access of the population to resources. At the country level, GDP per capita serves this purpose according to the UNDP methodology. Gross Regional Product (GRP) calculated by the manufacturing method is used instead of GDP for regional HDIs. Use of this indicator when computing the HDI is the most vulnerable point in regional HDI measurement methodology since high proportions of export-oriented sectors in GDP may produce a picture of token economic welfare of the region's population.

Taking into account critiques about using per capita GRP as an indicator describing the population's access to resources for decent living standards, the GDP index has also been used when gathering data and calculating regional HDIs for national human development reports.

It should be noted that per capita GRP and the national level of monetary incomes differed by 2.9 – 3.5 times in 1993-2003 for three main reasons. Firstly, monetary incomes of the surveyed households contain a systemic mistake connected to their underestimation: macro level underestimation ranged from one fourth to one third of declared monetary incomes. Secondly, GRP contains in-kind incomes of the population accounting for up to a quarter of monetary incomes and cost estimates of individual commodities that households already own. These include, for example, the relative cost of living in owned housing. Thirdly, in terms of consumptive use, GRP includes incomes used both for consumption and savings. In addition, it is worth noting that summary GYP by oblasts (GRP) does not equal GDP relative to GYP when not distributed by regions.

Exchange of per capita monetary incomes into USD at PPP will lead to underestimation of access to resources. Therefore, to ensure that the results are the same at the national level per capita, monetary incomes exchanged into USD through PPP are multiplied by a coefficient equal to the ratio of per capita GDP to per capita monetary incomes. This coefficient is used to correct regional per capita monetary incomes, which results in regional monetary incomes of the population coinciding with the national average.

8. Kazakhstan's HDI by settlement (urban/rural)

Baseline indicators broken down by urban/rural area should be available in order to calculate the HDI by settlement. Despite some difficulties, all indicators, apart from GDP per capita, are now calculated with an urban/rural breakdown.

In order to differentiate between rural and urban GDP, national human development reports have employed the methodology used to calculate gender-disaggregated GDP. Therefore, earned income is distributed between men and women in proportion to their respective wages in order to calculate gender-related GDP, while urban/rural income per capita is used to calculate urban/rural GDP.

ANNEX 2. STATISTICAL ANNEXES

Table 1.
Regional HDI rankings, Kazakhstan, 2005

Place	Oblast[1]	Oblast's HDI based on income[1]	For reference: countries with similar HDI[2]	National position in global HDI rankings[2]	National HDI[2]
2005		**2005**		**2004**	**2004**
1	Astana City	0,856	Slovakia	42	0,856
2	Almaty City	0,834	United Arab Emirates	49	0,839
3	Manghistau	0,803	Romania, Malaysia	60-61	0,805
4	Aktobe	0,801	Bosnia and Herzegovina, Mauritius	62-63	0,800
5	Atyrau	0,794	Belarus	67	0,794
6	West Kazakhstan	0,793	Dominica	68	0,793
7	Pavlodar	0,789	Columbia, Saint Lucia	70-71	0,790
8	Karagandy	0,784	Venezuela, Albania, Thailand	72-74	0,784
9	East Kazakhstan	0,779	West Samoa	75	0,778
10	South Kazakhstan	0,773	Ukraine	77	0,774
11	Zhambyl	0,772	Lebanon	78	0,774
12	Kostanai	0,770	Kazakhstan	79	0,774
13	Akmola	0,768	Armenia, China	80-81	0,768
14	Almaty	0,766	Peru	82	0,767
15	North Kazakhstan	0,765	Ecuador	83	0,765
16	Kyzylorda	0,764	Philippines	84	0,863

Sources: 1) calculated by the author using data of the RK Statistics Agency.
2) UNDP Human Development Report 2006.

Table 2.
Basic human development indicators and related indexes, by region, 2005

Oblast	Life expectancy	Literacy rate	Enrolment rate	Income per capita at PPP	Life expectancy index	Education index	GDP index	HDI
Akmola	63,5	99,4	79,3	4296	0,642	0,927	0,737	0,768
Aktobe	65,7	99,7	90,4	10292	0,679	0,966	0,759	0,801
Almaty	66,4	99,4	***67,7***	3228	0,690	***0,888***	0,719	0,766
Atyrau	66,7	99,7	87,4	**32649**	0,694	0,956	0,730	0,794
East Kazakhstan	64,8	99,2	79,6	5244	0,663	0,927	0,748	0,779
Zhambyl	67,0	99,7	78,8	***2742***	0,700	0,927	0,688	0,772
West Kazakhstan	66,5	99,4	85,8	13388	0,691	0,949	0,738	0,793
Karagandy	***64,0***	99,5	86,2	7729	***0,649***	0,951	0,753	0,784
Kostanai	65,3	99,4	78,0	5916	0,671	0,923	0,716	0,770
Kyzylorda	66,0	99,6	80,6	6900	0,684	0,933	0,675	0,764
Manghistau	65,0	99,5	95,3	20715	0,666	0,981	0,761	0,803
Pavlodar	65,6	99,4	86,0	8121	0,677	0,949	0,742	0,789
North Kazakhstan	64,9	99,2	71,5	4382	0,665	0,900	0,729	***0,765***
South Kazakhstan	67,4	99,9	83,3	2598	0,706	0,944	***0,668***	0,773
Astana City	**70,7**	99,7	89,1	19417	**0,762**	0,962	**0,846**	**0,856**
Almaty City	67,4	99,8	**100,0**	16629	0,707	**0,999**	0,795	0,834
Kazakhstan	**65,9**	**99,5**	**85,0**	**8068**	**0,682**	**0,947**	**0,733**	**0,787**
Maximum/minimum	**1,114**	**1,007**	**1,476**	**12,6**	**1,187**	**1,124**	**1,266**	**1,121**

Source: calculated by the author using data of the RK Statistics Agency and regional values of per capita income spent on consumption.
Note: The highest value in each year is highlighted in bold, while the lowest is in bold italics.

Table 3.
Individual human development indicators adjusted by gender, Kazakhstan, 1999-2005

Indicator	1999	2000	2001	2002	2003	2004	2005	Variation
Average life expectancy at birth, years [1]	65,5	65,5	65,8	66,0	65,8	66,18	65,91	0,4
including: women [1]	71,0	71,1	71,3	71,5	71,5	72,00	71,77	0,8
men [1]	60,3	60,2	60,5	60,7	60,5	60,62	60,30	0,0
Gender difference, years [1]	10,7	10,9	10,8	10,8	11,0	11,4	11,5	-0,8
Proportion of employed women among hired employees, % [1]	47,6	42.2	49,1	49,0	49,1	49,0	48,9	+1,3
Female to male wage ratio, % [1]	67,6	61,5	58,7	61,7	60,8	61,7	61,1	-6,5
GDP per capita, USD[2]	4293	4487	5219	5862	6532	7260	8068	3775
including: women [2]	3152	2683	3637	4212	4652	5211	5745	2593
men [2]	5521	6428	6923	7640	8556	9467	10571	5050
Gender difference, USD [2]	2369	3745	3286	3428	3903	4256	4826	2456

Sources: 1) Data provided by the RK Statistics Agency.
2) Calculated by the author.

Table 4.
Kazakhstan's gender-adjusted indexes of human development components and HDI, 1999-2005

Indicator	1999	2000	2001	2002	2003	2004	2005	Variation
Life expectancy index	0,767 / 0,588	0,768 / 0,587	0,772 / 0,592	0,775 / 0,595	0,775 / 0,592	0,783 / 0,594	0,780 / 0,588	0,013 / 0,000
Education index	0,925 / 0,915	0,925 / 0,915	0,929 / 0,919	0,940 / 0,927	0,945 / 0,929	0,952 / 0,935	0,955 / 0,939	0,030 / 0,023
GDP index	0,576 / 0,669	0,549 / 0,695	0,600 / 0,707	0,624 / 0,624	0,641 / 0,743	0,660 / 0,759	0,676 / 0,778	0,100 / 0,108
HDI	0,756 / 0,724	0,748 / 0,732	0,767 / 0,739	0,780 / 0,749	0,787 / 0,754	0,798 / 0,763	0,804 / 0,768	0,048 / 0,044

Note: numerator — women; denominator — men.

Table 5.
Kazakhstan's gender (un) adjusted indexes of human development components and HDI using UNDP methodology, 1999-2005

Indicator	1999	2000	2001	2002	2003	2004	2005	Variation
Life expectancy index	0,767 / 0,588	0,768 / 0,587	0,772 / 0,592	0,775 / 0,595	0,775 / 0,592	0,783 / 0,594	0,780 / 0,588	0,013 / 0,000
Education index	0,925 / 0,915	0,925 / 0,915	0,929 / 0,919	0,940 / 0,927	0,945 / 0,929	0,952 / 0,935	0,955 / 0,939	0,030 / 0,023
GDP index	0,576 / 0,669	0,549 / 0,695	0,600 / 0,707	0,624 / 0,624	0,641 / 0,743	0,660 / 0,759	0,676 / 0,778	0,100 / 0,108
HDI	0,756 / 0,724	0,748 / 0,732	0,767 / 0,739	0,780 / 0,749	0,787 / 0,754	0,798 / 0,763	0,804 / 0,768	0,048 / 0,044

Note: : numerator — gender-adjusted; denominator — not gender-adjusted.

Table 6.
National and regional HDIs in Kazakhstan based on GRP per capita, 1990-2005

Oblast	1990	1991	1992	1993	1994	1995	1996	1997
Akmola oblast including Astana City	0,762	0,765	0,748	0,755	0,733	0,706	0,701	0,704
Akmola	...	...	...	...	...	...	...	0,696
Aktobe	0,793	0,784	0,772	0,766	0,750	0,734	0,729	0,738
Almaty	0,764	0,751	0,741	0,718	0,706	0,693	0,712	0,713
Atyrau	0,773	0,762	0,765	0,733	**0,760**	**0,766**	0,776	0,781
East Kazakhstan	0,773	0,764	0,760	0,739	0,731	0,723	0,716	0,720
Zhambyl	0,763	0,742	0,748	0,707	***0,686***	***0,664***	***0,695***	***0,685***
West Kazakhstan	0,786	0,775	0,751	0,745	0,721	0,703	0,699	0,726
Karagandy	0,774	0,770	0,781	0,758	0,752	0,744	0,723	0,729
Kostanai	0,803	0,788	**0,805**	0,793	0,768	0,729	0,728	0,746
Kyzylorda	***0,749***	***0,731***	***0,737***	0,712	0,707	0,695	0,711	0,710
Manghistau	0,771	0,777	0,785	***0,702***	0,758	0,777	0,785	0,769
Pavlodar	0,777	0,777	0,787	0,774	0,764	0,755	0,754	0,737
North Kazakhstan	**0,793**	**0,800**	0,780	0,746	0,748	0,744	0,750	0,734
South Kazakhstan	0,765	0,758	0,746	0,719	0,700	0,676	0,699	0,703
Astana City	...	...	...	...	...	...	...	0,724
Almaty City	0,802	0,791	0,770	**0,782**	0,769	0,767	**0,802**	**0,821**
KAZAKHSTAN	**0,776**	**0,769**	**0,766**	**0,748**	**0,738**	**0,726**	**0,732**	**0,735**

Table 6 continued

Oblast	1998	1999	2000	2001	2002	2003	2004	2005
Akmola oblast including Astana City	0,715	0,737	0,740	0,747	0,762	0,777	0,785	0,803
Akmola	0,692	0,715	0,708	0,715	0,725	0,722	0,731	0,732
Aktobe	0,746	0,747	0,742	0,751	0,763	0,773	0,793	0,806
Almaty	0,707	0,700	0,696	0,710	0,715	0,715	0,720	0,720
Atyrau	0,777	0,785	0,813	0,825	0,837	0,853	0,866	0,872
East Kazakhstan	0,730	0,737	0,729	0,738	0,742	0,745	0,755	0,750
Zhambyl	***0,684***	***0,684***	***0,676***	***0,687***	***0,699***	***0,708***	***0,721***	***0,727***
West Kazakhstan	0,728	0,739	0,754	0,764	0,775	0,780	0,799	0,819
Karagandy	0,729	0,745	0,748	0,754	0,760	0,765	0,773	0,775
Kostanai	0,736	0,734	0,731	0,739	0,743	0,748	0,757	0,758
Kyzylorda	0,699	0,699	0,710	0,721	0,742	0,752	0,770	0,774
Manghistau	0,768	0,780	0,793	0,795	0,811	0,823	0,837	0,846
Pavlodar	0,755	0,745	0,751	0,763	0,771	0,780	0,793	0,787
North Kazakhstan	0,710	0,719	0,706	0,725	0,723	0,723	0,733	0,732
South Kazakhstan	0,699	0,706	0,713	0,724	0,728	0,730	0,737	0,731
Astana City	0,757	0,773	0,782	0,786	0,807	0,831	0,840	0,868
Almaty City	**0,823**	**0,828**	**0,821**	**0,839**	**0,850**	**0,852**	**0,849**	**0,853**
KAZAKHSTAN	**0,736**	**0,742**	**0,743**	**0,754**	**0,765**	**0,772**	**0,782**	**0,787**

Source: calculated by the author using data of the RK Statistics Agency and GRP per capita at the regional level.
Note: The highest value in each year is highlighted in bold, while the lowest is in bold italics.

Table 7.

National and regional GDP (GRP) in Kazakhstan, 1990-2005 USD at PPP

Oblast	1990	1991	1992	1993	1994	1995	1996	1997
Akmola oblast including Astana City	4849	5388	4022	5885	4577	3419	3061	3026
Akmola	0	0	0	0	0	0	0	2698
Aktobe	7750	6903	5593	6475	5652	5077	4204	4995
Almaty	5238	4355	3680	3091	2560	2263	2919	2767
Atyrau	7224	6139	6536	4732	**8558**	9987	11096	**11431**
East Kazakhstan	6480	5680	5380	4734	4656	5063	4394	4539
Zhambyl	5825	4188	4681	2890	2010	***1557***	2501	***2049***
West Kazakhstan	7095	6045	4001	4596	3611	2962	2693	3856
Karagandy	6368	6153	7659	6542	6710	7444	5257	5489
Kostanai	**9121**	7248	**9943**	10309	7086	4320	4019	5380
Kyzylorda	***4270***	***3137***	3544	2900	2727	2662	3155	3016
Manghistau	6337	7415	8753	***2481***	7373	**11894**	**13571**	9838
Pavlodar	6618	7004	8490	**8623**	8457	8489	7377	5115
North Kazakhstan	8185	**9672**	6864	4759	5116	5790	6404	4689
South Kazakhstan	4620	4266	***3447***	2722	***2002***	1574	***2304***	2194
Astana City	0	0	0	0	0	0	0	4041
Almaty City	6601	5644	3929	6182	5185	5188	9369	10327
KAZAKHSTAN	**6283**	**5756**	**5561**	**5204**	**4711**	**4508**	**4682**	**4628**

Table 7 continued

Oblast	1998	1999	2000	2001	2002	2003	2004	2005
Akmola oblast including Astana City	3372	4541	4590	5480	6477	7584	9168	10639
Akmola	2331	3134	2732	3324	3482	3660	4050	4296
Aktobe	5108	4391	4505	5207	6161	7073	8209	10292
Almaty	2381	2073	2036	2488	2681	2829	3013	3228
Atyrau	9120	**10207**	**15348**	**17398**	**21449**	**26451**	**26567**	**32649**
East Kazakhstan	4755	4437	4050	4416	4507	4698	4990	5244
Zhambyl	***1784***	***1551***	***1473***	***1610***	***1850***	***2273***	***2535***	***2742***
West Kazakhstan	3712	4103	5190	6338	7206	7835	11157	13388
Karagandy	5178	5347	5447	5766	6038	6699	7135	7729
Kostanai	4621	4349	4247	4461	4631	5167	5567	5916
Kyzylorda	2486	2084	2489	2923	3911	4608	5491	6900
Manghistau	7388	8813	11077	11793	14703	14253	15884	20715
Pavlodar	6500	4831	5530	6429	6552	7526	8439	8121
North Kazakhstan	3268	3234	2597	3539	3488	3612	4133	4382
South Kazakhstan	1916	1942	2211	2619	2632	2735	2646	2598
Astana City	6207	7777	8155	9017	11002	13387	16532	19417
Almaty City	**10448**	10024	9115	11771	13843	15144	16927	16629
KAZAKHSTAN	**4379**	**4293**	**4487**	**5219**	**5862**	**6532**	**7273**	**8068**

Source: calculated by the author using data of the RK Statistics Agency and GRP per capita at the regional level.
Note: The highest value in each year is highlighted in bold, while the lowest is in bold italics.

Table 8.

National and regional HDIs based on income spent on consumption, per capita, Kazakhstan, 1993-2005

Oblast	1993	1994	1995	1996	1997	1998
Akmola oblast including Astana City	0,759	0,731	0,717	0,718	0,733	0,740
Akmola	…	…	…	…	…	…
Aktobe	0,744	0,732	0,723	0,729	0,721	0,724
Almaty	0,726	0,716	0,700	0,708	0,710	***0,709***
Atyrau	0,724	0,723	0,717	0,723	0,730	0,739
East Kazakhstan	0,749	0,733	0,717	0,720	0,728	0,737
Zhambyl	***0,720***	0,717	0,711	0,718	***0,707***	0,716
West Kazakhstan	0,747	0,726	0,715	0,714	0,721	0,725
Karagandy	0,771	0,759	0,740	0,738	0,741	0,736
Kostanai	0,764	0,740	0,731	0,730	0,743	0,735
Kyzylorda	0,736	0,724	0,706	0,737	0,744	0,740
Manghistau	0,750	0,739	0,743	0,740	0,745	0,763
Pavlodar	0,753	0,738	0,728	0,734	0,736	0,737
North Kazakhstan	0,750	0,734	0,719	0,732	0,728	0,710
South Kazakhstan	0,723	***0,710***	***0,697***	***0,708***	0,715	0,715
Astana City	…	…	…	…	…	0,779
Almaty City	**0,806**	**0,799**	**0,792**	**0,794**	**0,812**	**0,813**
KAZAKHSTAN	**0,748**	**0,738**	**0,726**	**0,732**	**0,735**	**0,736**

Table 8 continued

Oblast	1999	2000	2001	2002	2003	2004	2005
Akmola oblast including Astana City	0,731	0,747	0,765	0,778	0,790	0,798	0,807
Akmola	***0,708***	0,737	0,745	0,758	0,758	0,763	0,768
Aktobe	0,734	0,746	0,757	0,771	0,780	0,792	0,801
Almaty	0,710	0,724	0,737	0,746	0,752	0,764	0,766
Atyrau	0,743	0,744	0,757	0,768	0,774	0,785	0,794
East Kazakhstan	0,745	0,742	0,754	0,763	0,768	0,777	0,779
Zhambyl	0,726	***0,715***	***0,723***	***0,742***	***0,744***	0,765	0,772
West Kazakhstan	0,734	0,742	0,748	0,761	0,773	0,787	0,793
Karagandy	0,750	0,745	0,755	0,767	0,770	0,778	0,784
Kostanai	0,734	0,738	0,749	0,755	0,756	0,764	0,770
Kyzylorda	0,744	0,726	0,731	0,742	0,755	0,763	0,764
Manghistau	0,750	0,741	0,754	0,767	0,787	0,798	0,803
Pavlodar	0,744	0,748	0,760	0,763	0,774	0,785	0,789
North Kazakhstan	0,723	0,745	0,760	0,754	0,759	***0,762***	***0,765***
South Kazakhstan	0,724	0,733	0,739	0,751	0,755	0,769	0,773
Astana City	0,768	0,768	0,794	0,812	**0,831**	**0,842**	**0,856**
Almaty City	**0,813**	**0,803**	**0,821**	**0,829**	0,829	0,830	0,834
KAZAKHSTAN	**0,742**	**0,743**	**0,754**	**0,765**	**0,772**	**0,782**	**0,787**

Source: calculated by the author using data of the RK Statistics Agency and GRP per capita at the regional level.
Note: The highest value in each year is highlighted in bold, while the lowest is in bold italics.

Table 9.

National and regional income spent on consumption, per capita, Kazakhstan, 1993-2005 USD at PPP

Oblast	1993	1994	1995	1996	1997	1998
Akmola oblast including Astana City	6313	4412	4105	4121	5085	5319
Akmola	0	0	0	0	0	0
Aktobe	4329	4070	4157	4272	3681	3473
Almaty	3586	3074	2544	2723	***2646***	***2458***
Atyrau	3985	4400	4183	4303	4520	4573
East Kazakhstan	5699	4829	4524	4692	5270	5399
Zhambyl	3640	3496	3658	3725	3046	3211
West Kazakhstan	4785	3950	3682	3513	3560	3647
Karagandy	8257	7591	6925	6856	6821	5985
Kostanai	6139	4237	4429	4187	5176	4548
Kyzylorda	4492	3694	3239	5027	5565	5294
Manghistau	5953	5284	6461	6057	6408	6276
Pavlodar	5868	5379	5278	5085	5016	4653
North Kazakhstan	5142	3975	3741	4661	4201	3397
South Kazakhstan	***2927***	***2394***	***2320***	***2699***	2714	2547
Astana City	0	0	0	0	0	7557
Almaty City	**9528**	**8830**	**8226**	**8163**	**8723**	**8203**
KAZAKHSTAN	**5204**	**4711**	**4508**	**4682**	**4628**	**4379**

Table 9 continued

Oblast	1999	2000	2001	2002	2003	2004	2005
Akmola oblast including Astana City	4096	5200	7511	8587	9631	10266	11461
Akmola	2791	4608	5729	6196	7003	7442	8256
Aktobe	3469	4803	5753	7044	8122	8516	9447
Almaty	***2473***	3360	4029	4608	5483	6705	7438
Atyrau	4753	4472	5148	6215	6363	7165	7948
East Kazakhstan	5084	5117	5910	6562	7038	7970	8841
Zhambyl	3299	2965	***3117***	***3950***	4341	5545	6151
West Kazakhstan	3750	4233	4790	5622	6919	7506	8326
Karagandy	5903	5163	5945	6881	7412	8192	9087
Kostanai	4341	4852	5274	5787	6016	6561	7279
Kyzylorda	4642	3309	3530	3960	4900	5138	5700
Manghistau	5198	4389	5632	6648	7422	8589	9528
Pavlodar	4691	5194	6053	5674	6821	7672	8511
North Kazakhstan	3450	5211	6568	6106	6846	7124	7903
South Kazakhstan	2698	***3164***	3427	3960	***4268***	***4943***	***5484***
Astana City	7096	6336	**10434**	**12199**	**13516**	**14329**	**15895**
Almaty City	**7628**	**6585**	8403	9501	10080	10572	11728
KAZAKHSTAN	**4293**	**4487**	**5219**	**5862**	**6532**	**7273**	**8068**

Source: calculated by the author using data of the RK Statistics Agency and regional values of per capita income spent on consumption.
Note: The highest value in each year is highlighted in bold, while the lowest is in bold italics.

Table 10.
Proportion of population not surviving to age 60, by oblast, 1998-2005

Oblast	1998	1999	2000	2001	2002	2003	2004	2005
Akmola oblast including Astana City	34,5	30,6	30,3	31,6	30,3	30,3	30,4	30,6
Akmola	35,8	32,0	33,1	**35,4**	33,7	**35,7**	35,1	35,7
Aktobe	34,0	30,8	**34,3**	34,8	**34,6**	33,6	32,2	31,2
Almaty	29,2	28,0	28,2	27,5	27,0	28,0	28,2	29,5
Atyrau	34,1	**33,6**	33,2	32,2	33,6	30,9	30,0	28,5
East Kazakhstan	36,8	31,6	33,4	31,9	32,1	31,8	32,0	33,1
Zhambyl	30,5	27,4	30,3	28,9	27,9	29,3	28,2	27,9
West Kazakhstan	33,7	30,9	32,0	32,2	33,0	32,8	30,0	29,5
Karagandy	**37,8**	33,3	33,2	33,8	33,9	35,3	**36,1**	**35,9**
Kostanai	32,8	31,0	31,6	30,7	30,2	31,7	31,8	32,3
Kyzylorda	30,8	28,6	27,5	27,5	28,2	26,7	26,0	28,1
Manghistau	34,0	31,0	31,1	33,8	32,6	30,2	29,7	30,1
Pavlodar	35,0	30,2	31,2	31,6	30,6	30,4	30,7	31,2
North Kazakhstan	35,0	31,6	32,3	32,4	33,0	33,3	33,2	33,0
South Kazakhstan	29,2	26,1	26,2	26,1	26,7	26,5	25,9	26,9
Astana City	31,1	27,4	***24,9***	***25,3***	***25,1***	***22,4***	***23,6***	***23,6***
Almaty City	***27,5***	***27,0***	27,1	26,0	25,2	26,5	28,5	29,6
KAZAKHSTAN	**33,0**	**29,9**	**30,5**	**30,3**	**30,1**	**30,3**	**30,3**	**30,7**

Source: calculated by the author using data of the RK Statistics Agency.
Note: The highest value in each year is highlighted in bold, while the lowest is in bold italics.

Table 11.
Proportion of 16-year-olds not enrolled in education, 1998-2005

Oblast	1998	1999	2000	2001	2002	2003	2004	2005
Akmola oblast including Astana City	13,6	12,2	13,7	15,8	7,2	5,5	7,1	6,9
Akmola	15,5	13,6	4,1	7,7	6,2	9,2	**12,0**	**12,0**
Aktobe	9,2	6,1	7,2	5,2	***0,0***	***0,0***	2,7	2,7
Almaty	13,7	10,0	14,8	**15,5**	10,8	7,4	7,5	7,5
Atyrau	6,5	7,0	6,2	5,4	***0,0***	***0,0***	0,2	0,2
East Kazakhstan	10,7	5,0	8,1	9,0	7,3	3,0	4,2	4,2
Zhambyl	9,6	**14,0**	**17,5**	14,7	8,7	4,7	7,0	7,0
West Kazakhstan	12,0	4,0	***0,0***	5,4	***0,0***	***0,0***	***0,0***	***0,0***
Karagandy	11,7	5,5	10,7	10,8	3,6	0,1	3,2	3,2
Kostanai	6,3	7,0	14,2	12,0	**11,0**	**10,1**	7,4	7,4
Kyzylorda	**16,2**	8,0	12,4	14,0	***0,0***	4,5	1,5	1,5
Manghistau	8,7	6,0	0,2	5,0	***0,0***	***0,0***	***0,0***	***0,0***
Pavlodar	11,4	7,0	11,3	14,0	2,4	1,6	1,7	1,7
North Kazakhstan	14,4	4,0	7,0	6,1	3,5	2,7	5,3	5,3
South Kazakhstan	8,4	9,0	8,9	11,7	1,8	0,8	0,0	0,0
Astana City	8,5	9,0	32,1	29,0	8,7	***0,0***	***0,0***	***0,0***
Almaty City	***4,9***	***4,0***	***0,0***	***0,0***	***0,0***	***0,0***	***0,0***	***0,0***
KAZAKHSTAN	**10,8**	**11,6**	**9,8**	**10,6**	**4,5**	**3,0**	**1,1**	**1,1**

Source: calculated by the author using data of the RK Statistics Agency.
Note: The highest value in each year is highlighted in bold, while the lowest is in bold italics.

Table 11.
Proportion of 16-year-olds not enrolled in education, 1998-2005

Oblast	1998	1999	2000	2001	2002	2003	2004	2005
Akmola oblast including Astana City	13,6	12,2	13,7	15,8	7,2	5,5	7,1	6,9
Akmola	15,5	13,6	4,1	7,7	6,2	9,2	**12,0**	**12,0**
Aktobe	9,2	6,1	7,2	5,2	***0,0***	***0,0***	2,7	2,7
Almaty	13,7	10,0	14,8	**15,5**	10,8	7,4	7,5	7,5
Atyrau	6,5	7,0	6,2	5,4	***0,0***	***0,0***	0,2	0,2
East Kazakhstan	10,7	5,0	8,1	9,0	7,3	3,0	4,2	4,2
Zhambyl	9,6	**14,0**	**17,5**	14,7	8,7	4,7	7,0	7,0
West Kazakhstan	12,0	4,0	***0,0***	5,4	***0,0***	***0,0***	***0,0***	***0,0***
Karagandy	11,7	5,5	10,7	10,8	3,6	0,1	3,2	3,2
Kostanai	6,3	7,0	14,2	12,0	**11,0**	**10,1**	7,4	7,4
Kyzylorda	**16,2**	8,0	12,4	14,0	***0,0***	4,5	1,5	1,5
Manghistau	8,7	6,0	0,2	5,0	***0,0***	***0,0***	***0,0***	***0,0***
Pavlodar	11,4	7,0	11,3	14,0	2,4	1,6	1,7	1,7
North Kazakhstan	14,4	4,0	7,0	6,1	3,5	2,7	5,3	5,3
South Kazakhstan	8,4	9,0	8,9	11,7	1,8	0,8	0,0	0,0
Astana City	8,5	9,0	32,1	29,0	8,7	***0,0***	***0,0***	***0,0***
Almaty City	***4,9***	***4,0***	***0,0***	***0,0***	***0,0***	***0,0***	***0,0***	***0,0***
KAZAKHSTAN	**10,8**	**11,6**	**9,8**	**10,6**	**4,5**	**3,0**	**1,1**	**1,1**

Source: calculated by the author using data of the RK Statistics Agency.
Note: The highest value in each year is highlighted in bold, while the lowest is in bold italics.

Table 12.
Proportion of population with income spent on consumption below the subsistence minimum, 1999-2005

Oblast	1999	2000	2001	2002	2003	2004	2005
Akmola oblast including Astana City	29,8	23,0	13,9	12,1	10,6	8,8	6,3
Akmola	35,4	28,9	21,0	18,6	16,4	14,0	10,1
Aktobe	24,3	18,3	29,8	22,6	19,0	14,3	12,3
Almaty	44,2	46,2	39,3	36,3	25,3	15,2	8,5
Atyrau	50,1	49,6	40,7	34,1	**32,7**	**29,1**	**25,0**
East Kazakhstan	17,3	15,4	21,1	20,0	16,9	14,9	8,2
Zhambyl	45,7	47,7	48,2	35,8	30,0	18,3	10,8
West Kazakhstan	28,9	12,0	27,3	28,0	17,1	14,4	8,5
Karagandy	18,4	18,6	22,8	19,3	15,1	13,5	6,4
Kostanai	21,7	22,3	25,5	22,3	21,0	19,0	13,4
Kyzylorda	55,0	51,6	39,5	32,3	27,1	26,5	16,3
Manghistau	37,9	**59,7**	**45,9**	**39,8**	26,0	21,0	13,6
Pavlodar	48,0	14,9	16,6	21,6	17,1	14,5	4,7
North Kazakhstan	27,2	11,9	10,0	14,3	11,9	12,0	8,2
South Kazakhstan	**55,5**	52,8	39,2	27,5	26,1	23,0	13,3
Astana City	15,1	11,6	***2,2***	***2,2***	***2,1***	***1,1***	***1,1***
Almaty City	***13,7***	***4,8***	4,9	4,1	3,9	2,8	0,3
KAZAKHSTAN	**34,5**	**31,8**	**28,4**	**24,2**	**19,8**	**16,1**	**9,8**

Source: calculated by the author using data of the RK Statistics Agency.
Note: The highest value in each year is highlighted in bold, while the lowest is in bold italics.

Table 13.
Unemployment rate (%, at year end), 1999-2005

Oblast	1999	2000	2001	2002	2003	2004	2005
Akmola oblast including Astana City	14,2	12,6	10,2	9,0	8,9	8,8	8,6
Akmola	14,7	12,6	10,8	9,2	9,2	9,2	8,9
Aktobe	13,7	13,3	11,4	10,2	9,7	9,4	9,1
Almaty	14,2	14,1	10,2	9,2	8,6	7,8	7,3
Atyrau	15,1	**15,5**	13,5	10,7	9,5	9,3	9,0
East Kazakhstan	8,5	8,2	***7,3***	***7,3***	***7,3***	***7,2***	***7,4***
Zhambyl	14,6	14,4	12,7	12,3	11,1	**10,2**	**9,7**
West Kazakhstan	***7,8***	***7,8***	12,5	10,0	9,3	9,2	8,9
Karagandy	14,3	13,5	9,2	8,3	7,5	7,4	7,0
Kostanai	15,8	13,1	10,3	9,3	8,7	8,5	8,2
Kyzylorda	**16,1**	14,5	**13,9**	**12,5**	**11,4**	**10,2**	**9,7**
Manghistau	13,2	13,7	10,5	9,8	9,7	9,8	9,6
Pavlodar	13,4	13,8	9,2	8,7	8,2	7,7	8,1
North Kazakhstan	14,6	12,8	8,9	8,0	8,0	8,1	8,4
South Kazakhstan	14,1	14,3	11,5	9,4	8,6	7,8	7,4
Astana City	13,0	12,5	9,3	8,7	8,4	8,3	8,1
Almaty City	14,0	12,1	10,8	9,6	8,9	8,8	8,4
KAZAKHSTAN	**13,5**	**12,8**	**10,4**	**9,3**	**8,8**	**8,4**	**8,1**

Source: calculated by the author using data of the RK Statistics Agency.
Note: The highest value in each year is highlighted in bold, while the lowest is in bold italics.

Table 14.
Human Poverty Index, 1999-2005

Oblast	1999	2000	2001	2002	2003	2004	2005
Akmola oblast including Astana City	24,6	22,3	21,4	19,7	19,6	19,6	19,6
Akmola	27,5	25,0	24,0	22,5	23,4	23,0	**23,0**
Aktobe	22,6	23,1	26,0	23,8	22,5	21,0	20,2
Almaty	30,4	31,7	27,8	25,9	21,4	18,9	18,9
Atyrau	34,7	34,4	29,6	27,0	**25,4**	**23,6**	21,5
East Kazakhstan	21,1	21,9	22,1	21,9	21,1	20,9	21,0
Zhambyl	31,2	33,1	**32,8**	26,0	23,8	19,6	18,2
West Kazakhstan	23,8	20,6	24,1	24,5	21,7	19,7	18,9
Karagandy	22,6	22,7	23,6	22,7	22,9	23,2	22,7
Kostanai	22,3	22,9	23,0	21,7	22,0	21,6	21,0
Kyzylorda	**36,5**	34,4	28,0	24,4	21,6	21,0	19,0
Manghistau	27,9	**39,4**	32,4	**29,1**	22,6	20,9	19,7
Pavlodar	32,8	21,1	21,5	21,4	20,3	20,1	19,8
North Kazakhstan	23,9	21,1	20,8	21,4	21,4	21,4	21,0
South Kazakhstan	36,4	34,8	27,3	21,7	21,0	19,6	17,7
Astana City	18,9	23,5	21,8	16,2	***14,4***	***15,1***	***15,1***
Almaty City	***18,4***	***17,6***	***16,8***	***16,2***	16,9	18,1	18,8
KAZAKHSTAN	**26,2**	**25,1**	**23,7**	**22,0**	**20,9**	**20,1**	**19,7**

Source: calculated by the author using data of the RK Statistics Agency.
Note: The highest value in each year is highlighted in bold, while the lowest is in bold italics.

Table 15.
Staff engaged in research and development, by type of organization * (staff)

Type of organization	Year					
	2000	2001	2002	2003	2004	2005
Staff engaged in R&D at workplace, total	14756	15339	15998	16578	17343	18912
Scientific establishments	9508	7008	6802	8200	11132	12659
Higher education establishments	4305	6845	7542	6130	3795	4035
Planning and design centers	520	912	827	912	873	972
Departments at industrial plants	378	316	510	283	360	344
Other	45	258	317	1053	1183	902

* *- Not including faculty engaged in R&D along with educational work*
Source: data provided by the RK National Center for Scientific and Technical Information

Table 16.
Highly qualified professionals out of all researchers (people)

Indicator	2000 г.		2005 г.	
	number	%	number	%
Researchers, total	9009	-	11910	-
including: doctors and candidates of science, total	3745	100	4124	100
of which: doctors of science	948	25,3	1106	26,8
candidates of science	2797	74,7	3018	73,2

Source: data provided by the RK National Center for Scientific and Technical Information

Table 17.
Average annual fixed assets spent on R&D, 2000-2005

Indicator	Year					
	2000	2001	2002	2003	2004	2005
Average annual fixed assets spent on R&D, mln. tenge	6902,9	6548,7	8024,0	9037,3	12396,6	14584,2
including cost of machinery and equipment, mln. tenge	1489,3	2430,4	3065,6	4091,1	5104,7	7105,7
Active assets in average annual fixed assets, %	21,6	37,1	38,2	45,3	41,2	48,7
People engaged in research, thousand people	14,8	15,3	16,0	16,6	17,3	18,9
Capital/labor ratio, mln. tenge	466,4	428,0	501,5	544,4	716,6	771,7

(Source: data provided by the RK National Center for Scientific and Technical Information for 2006)

Table 18.
GDP and expenditure on R&D in Kazakhstan, 2000-2005 (bln. tenge)

Indicator	Year					
	2000	2001	2002	2003	2004	2005
GDP	2600,0	3250,6	3776,3	4612,0	5870,1	7457,1
R&D	6,1	9,2	13,8	14,4	18,5	29,6
Total R&D costs	6,0	8,9	12,8	14,4	18,5	29,2
Of which:						
external	1,3	1,8	3,2	2,8	4,0	7,7
internal	4,7	7,1	9,6	11,6	14,6	21,5
Share of R&D in GDP, %	0,18	0,22	0,25	0,25	0,25	0,29
R&D costs funded from the national budget	1,9	2,8	4,0	4,9	7,3	11,0
Funds of the national budget in total internal costs, %	40,4	39,4	41,7	42,2	50,0	51,2

(Source: data provided by the RK National Center for Scientific and Technical Information, for 2006)

Table 19.
R&D costs, per capita

Indicator	Year					
	2000	2001	2002	2003	2004	2005
Internal costs of R&D (mln.tenge)	4706,8	7154,0	9632,9	11643,5	14579,8	21527,4
Population (at year end), mln. people	14,9	14,9	14,9	14,9	15,1	15,2
R&D costs, per capita (tenge)	315,89	480,1	646,5	781,44	965,55	1416,28

(Source: data provided by the RK National Center for Scientific and Technical Information, for 2006)

Table 20.
R&D costs, by sources of funding, 2000-2005 (mln. tenge)

Показатели	Year					
	2000	2001	2002	2003	2004	2005
Gross costs, total	5965,7	8902,4	12824,7	14373,6	18556,3	29198,3
Internal costs	4706,8	7154,0	9632,9	11643,5	14579,8	21527,4
of which:						
National funds	1948,1	2787,8	3984,5	4875,0	7283,9	11015,6
Non-governmental sources	35,6	61,0	39,0	2,6	55,3	99,7
Internal funds	857,3	1592,7	2539,4	1616,9	2673,5	4392,7
Funds of clients and customers	1759,5	2515,6	2989,9	4495,8	4223,7	5688,0
International investors	106,3	196,9	80,1	653,2	343,4	331,4
External costs	1258,9	1748,4	3191,8	2730,1	3976,5	7671,0

(Source: RK Statistics Agency, Research and Development, Series 20, Almaty)

Table 21.
Shares and rates of increase of internal costs of R&D, by sources of funding

Source of funding	Costs				Increase rate
	2000		2005		
	mln. tenge	%	mln. tenge	%	
Internal costs	4706,8	100	21527,4	100	2,9
of which: national funds	1948,1	41,4	11015,6	51,2	3,6
Funds of clients and customers	1759,5	37,4	5688,0	26,4	2,0
Internal funds	857,3	18,2	4392,7	20,4	3,2
International sources	141,9	3,0	431,1	2,0	1,9

(Source: : RK Statistics Agency, Research and Development, Series 20, Almaty)

Table 22.
Financial resources, by types of organization, 2000-2005 (mln. tenge)

Year	National total	of which, by main organizations				
		Research institutes	Planning and design centers	Higher education establishments	Industrial research	Other
Funds of the national budget						
2000	1948,1	1527,0	8,2	395,9	16,8	0,2
2001	2787,8	588,0	572,9	1284,8	195,5	146,6
2002	3984,5	1776,8	27,0	1994,2	4,0	182,5
2003	4875,0	2014,9	37,5	2232,0	7,8	582,8
2004	7283,9	4687,4	175,5	1682,1	3,8	735,1
2005	11015,6	8345,1	87,1	2114,4	1,2	467,8
Funds of clients and customers						
2000	1759,5	954,2	191	235,2	240,6	138,5
2001	2515,6	435,3	504,5	560,2	985,5	30,1
2002	2989,9	2130,9	162,7	649,0	-	47,3
2003	4495,8	2712,8	497,7	654,9	-	630,4
2004	4223,7	2882,5	511,6	302,9	72,8	453,9
2005	5688,0	3464,3	712,8	585,3	2,6	923,0
Internal funds						
2000	857,3	26,3	441,6	70	6,6	312,8
2001	1592,7	418,8	642,4	498,7	28,3	4,5
2002	2539,4	1399,4	400,7	186,6	541,7	11,1
2003	1616,9	1005,3	139,9	137,6	331,8	2,3
2004	2673,6	1548,2	519,8	53,4	496,6	55,6
2005	4392,7	3174,9	470,0	174,6	450,4	122,8

(Source: RK Statistics Agency, Research and Development, Series 20, Almaty)

Table 23.
GDP of CIS countries, 1990-2005 (as % of previous year)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Azerbaijan	88.3	99.3	77.4	76.9	80.3	88.2	101.3	105.8	110.0	107.4	111.1	109.9	110.6	111.2	110.2	126,4
Armenia	94.5	88.3	58.2	91.2	105.4	106.9	105.9	103.3	107.3	103.3	105.9	109.6	113.2	114.0	110.1	113,9
Belarus	98.1	98.8	90.4	92.4	88.3	89.6	102.8	111.4	108.4	103.4	105.8	104.7	105.0	107.0	111.0	109,2
Georgia	84.9	78.9	55.1	70.7	89.6	102.6	111.2	110.6	103.1	102.9	101.8	104.8	105.5	111.0	106.2	107,7
Kazakhstan	...	89.0	94.7	90.8	87.4	91.8	100.5	101.7	98.1	102.7	109.8	113.5	109.8	109.3	109.6	109,5
Kyrgyzstan	...	92.1	86.1	84.5	79.9	94.6	107.1	109.9	102.1	103.7	105.4	105.3	100.0	107.0	107.1	99,4
Moldova	97.6	82.5	71.0	98.8	69.1	98.6	94.1	101.6	93.5	96.6	102.1	106.1	107.8	106.6	107.3	108,4
Russia	97.0	95.0	85.5	91.3	87.3	95.9	96.4	101.4	94.7	106.4	110.0	105.1	104.7	107.3	107.2	106,4
Tajikistan	...	...	...	83.7	78.7	87.6	83.3	101.7	105.3	103.7	108.3	110.2	110.8	111.0	110.6	106,7
Turkmenistan	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Uzbekistan	...	99.5	88.9	97.7	94.8	99.1	101.7	105.2	104.4	104.4	103.8	104.2	104.0	104.2	107.7	107,2
Ukraine	...	91.3	90.1	85.8	77.1	87.8	90.0	97.0	98.1	99.8	105.9	109.2	105.2	109.6	112.1	102,4

Source: Kazakhstan and CIS States, issue 1 of 2000-2006. RK Statistics Agency. Brief Statistical Yearbook of Kazakhstan. Almaty, 2006.

Table 24.
Composition of Kazakhstan's GDP, 1990-2005 (as % of total)

Indicators	1990	1995	1997	1998	2000	2005
Production of goods	**66,5**	**42,3**	**37,0**	**37,9**	**45,9**	**44,1**
Industries	20,5	23,5	21,4	24,4	32,6	30,2
Agriculture, forestry and fishery	34,0	12,3	11,4	8,6	8,1	6,5
Building	12,0	6,5	4,2	4,9	5,2	7,4
Service delivery	**34,7**	**54,0**	**58,9**	**56,7**	**48,4**	**52,2**
Trade	8,2	17,2	15,7	15,1	12,4	12,4
Transport	8,6	9,4	10,3	12,3	10,0	9,3
Communications	0,8	1,3	1,4	1,5	1,5	2,1
Other services	17,1	26,1	31,5	27,8	24,5	28,4
Sectors, total	101,2	96,3	95,9	94,6	94,3	96,3
Financial Intermediary Services Indirectly Measured	-0,9	-0,7	-0,5	-0,6	-0,9	-2,2
Gross value added	100,3	95,6	95,4	94,0	93,4	94,1
Net taxes	-0,3	4,4	4,6	6,0	6,6	5,9
Financial Intermediation Services Indirectly Measured	-	-	-	-0,6	-0,9	-2,2
Gross Domestic Product	100	100	100	100	100	100

Source: Kazakhstan Through the Years of Independence. RK Statistics Agency. Almaty, 2006.

Table 25.
R&D and dissertations, by sectors

Sectors	Total		of which			
			R&D		dissertations	
	in absolute terms	%	in absolute terms	%	in absolute terms	%
Industries	37	50	21	56,8	16	43,2
Agriculture	1	1,4	1	100	-	-
Building	1	1,4	-	-	1	100
Transport and communications	1	1,3	-		1	100
Education	25	33,8	6	24	19	76
Health	4	5,4	1	25	3	75
Culture	2	2,7	-	-	2	100
Other sectors	3	4,0	-	-	3	100
Total	74	100	29	39,2	45	60,8

(Source: data provided by the RK National Center for Scientific and Technical Information for 2006)

Table 26.
Organizations most frequently subcontracted for preparation of economic R&D reports (fragment)

Organization	Rank	Inquired documents	Inquiries	Demand coefficient
Institute of Economy	1	27	48	1,8
Economic Research Institute	2	10	25	2,5
Kazakh National University named after al-Farabi	3	10	14	1,4
Financial and Bank Management Research Institute	4	7	13	1,9
Research Institute of AgroIndustrial Complex and Rural Development	5	6	14	2,3
Kazakh Economic University named after T. Ryskulov	6	6	7	1,2
Kazakh Academy of Education	7	6	7	1,2
Regional Development Institute	8	5	12	2,4
University of International Business	9	4	19	4,75

(Source: data provided by the RK National Center for Scientific and Technical Information for 2006)

Figure 1. - State registration of dissertations
(Source: data provided by the RK National Center for Scientific and Technical Information for 2006)

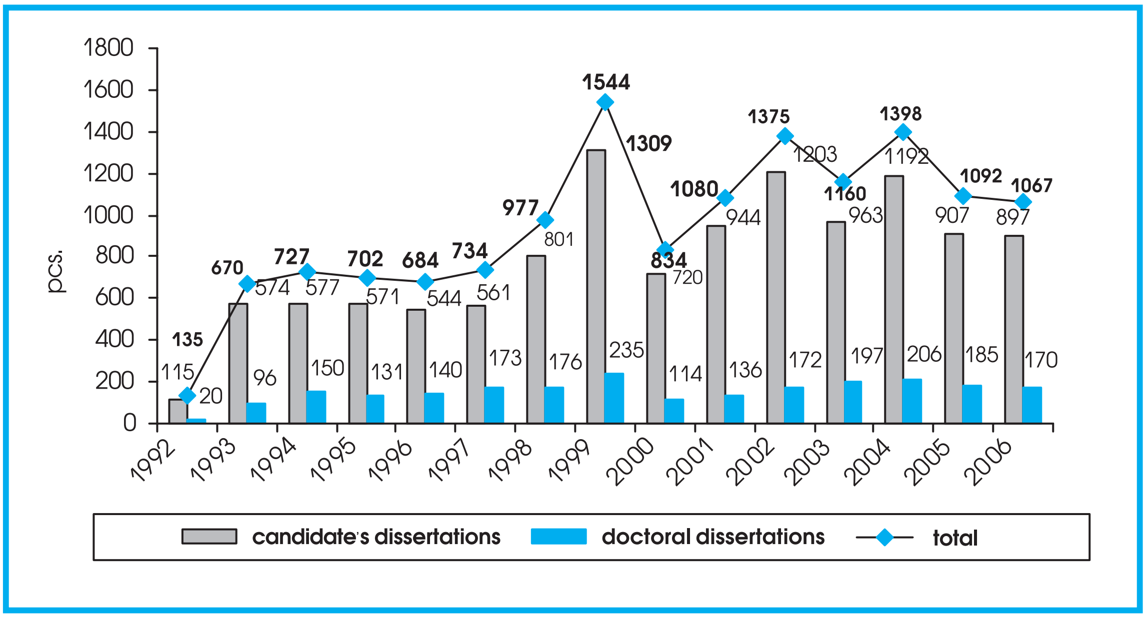


Figure 2. - Highly qualified personnel, by age
(Source: data provided by the RK National Center for Scientific and Technical Information for 2006)

Candidates of Science

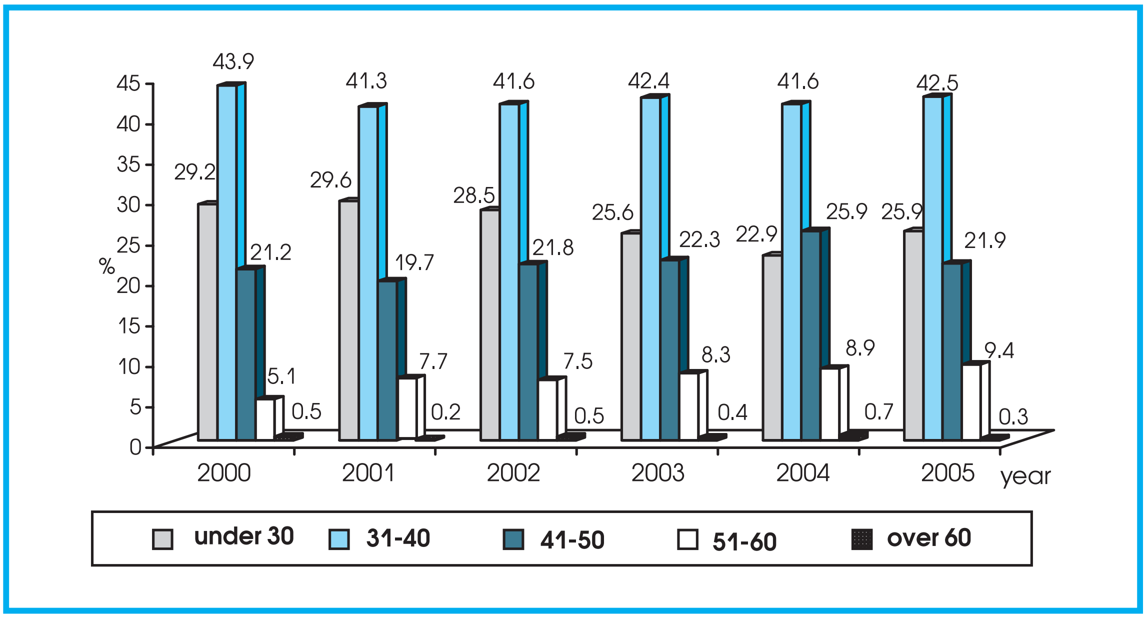
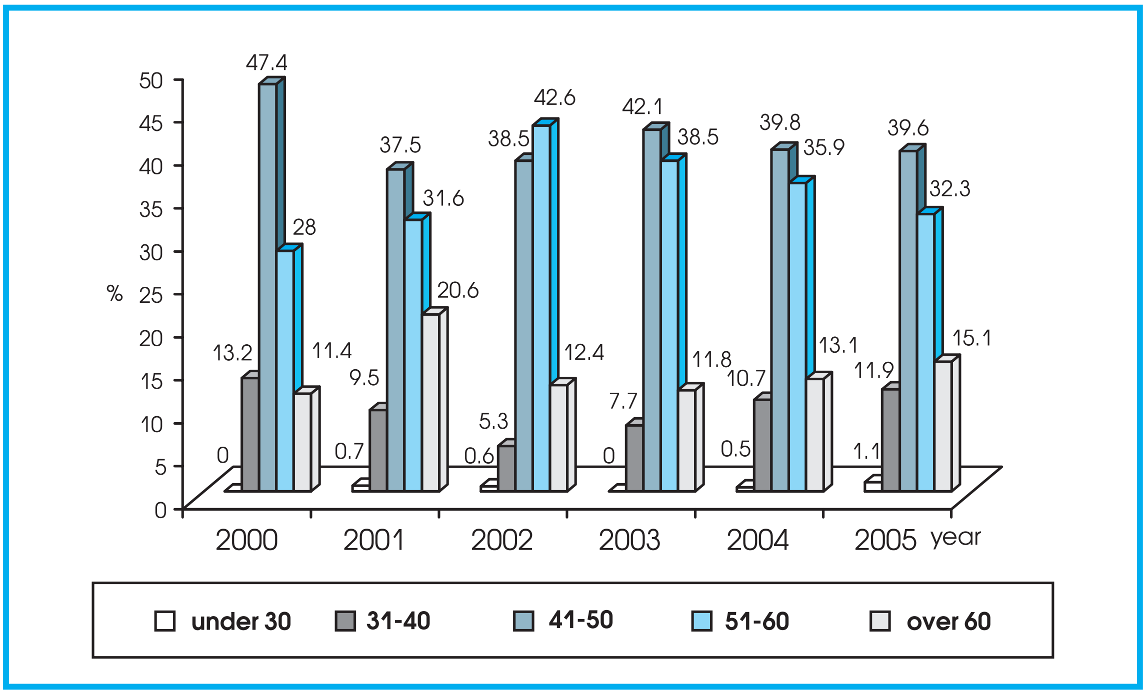


Figure 3. - Highly qualified personnel, by age
(Source: data provided by the RK National Center for Scientific and Technical Information for 2006)

Doctors of Science



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Authors' group:

1. Yuriy Shokamanov – first deputy chair, RK Statistics Agency
2. Erbol Suleymenov – general director, RK National Center for Scientific and Technical Information
3. Asan Jumabekov – expert, RK National Center for Scientific and Technical Information
4. Irina Aleksandrova – head of international relations department, RK National Center for Scientific and Technical Information
5. Gulnaz Alibekova – head of marketing and information department, RK National Center for Scientific and Technical Information
6. Iliyas Songgul – specialist, division for analysis of evidence-based justification of economic and innovative development, analytical department, RK National Center for Scientific and Technical Information
7. Dinara Seitova – expert, RK National Center for Scientific and Technical Information
8. Kanat Shakenov – deputy director general, RK National Biotechnology Center
9. Aidar Kazybaev – director general, Center for Modern Economy and Business
10. Saule Kairzhanova – economic development expert, Center for Modern Economy and Business
11. Gulnara Essengazina – chief project manager, JSC Center of Engineering and Transfer of Technology
12. Saltanat Tamabaeva – technological research manager, JSC Center of Engineering and Transfer of Technology

Consultative Board:

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6. Talgat Batpenov – vice-president, JSC Center of Engineering and Transfer of Technology
7. Saule Ospanova – UNDP Environmental and Sustainable Development Programme Coordinator
8. Gennady Doroshin – UNDP Project Manager (Kazakhstan - Wind Power market development initiative)

UNDP Coordination Group:

1. Alma Nurshaikhova – UNDP Human Development Programme Coordinator
2. Togzhan Assan – UNDP Programme Assistant

Technical support:

Maps – Lada Nikolayenko
Russian text editing – Valentina Semykina
Translated and edited in English – Seamus Bennett
Translated and edited in Kazakh – Kaisar Zhorabekov
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