Adequate Responses to Global Challenges

Assimilation of scientific advances into manufacturing is the main way to increase the economic security of a nation worldwide

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The influence of the external market competition is felt every day by the national economy and economic agents in their daily operation. It is an objective phenomenon one has to take into account and make serious conclusions. In this regard innovative development should be considered keeping in mind the ability of economic subjects to counteract external challenges as well as the subjects' potential of adapting to the challenges and achieving maximum manufacturing and financial benefits, first of all, as part of economic security considerations.

If We Talk About Specific Things

External price shocks – the global increase in prices for raw materials, fuel and energy resources as well as food – are some of the main threats to economic security of Belarus. Certainly one has to take into account existing direct and inverse economic links. Growing feedstock prices are largely compensated with simultaneously growing prices for exports.

According to the trade balance statistics in January-April 2008, Belarus' export increased by 65.3% in comparison with the same period of last year in cost terms, Belarus' import – 57.6%. The increase in the cost value of the foreign trade is mostly attributed to an increase in average prices for exports and imports (40.4% up and 28.5% up respectively). In natural terms Belarus' export swelled by 17.7%, import – 22.6%. It means the favourable correlation of prices for Belarusian exports and imports enabled the cost value of exports to stay ahead of that of imports even while the volume of imports grew faster in natural terms.

However, one should not expect the state of things to continue in the future. Rising trends on raw stock markets inevitably lead to growing import costs, which in turn will provoke galloping costs inside the country. Actually inflation is actively imported and it is virtually impossible to handle the problem with instruments of the national monetary management policy alone. The innovation and investment cycles also require predictable conditions for long-term investments as well as the implementation of strategies, which plan for dozens of years: high inflation is a dangerous threat to stable economic growth and investment attractiveness. Table 1 lists total inflation data for various regions and the world as a whole.

Table 1 indicates that in 2006-2007 the CIS states demonstrated some of the highest inflation indices in the world – 9.3% and 9.6% respectively. The share of food prices in the total price growth totalled 41.1% in 2007, the share of fuel – only 7.2%. In developed countries the figures are a bit different. In 2006 prices went up by 2.3%, with the food prices share as high as 12.4%, fuel prices share – 28%. In 2007 the figures totalled 19.5% and 12.1% respectively. Analysis indicates the poorer a country is, the higher the share of food prices in the overall inflation is. In Africa the contribution steadily exceeds 40%.

In Belarus the figures are contrary to the worst: in 2006 and 2007 consumer prices grew by 8.0% and 7.0% respectively. But taking into account the strategy of our neighbours and key trade partners one should not rely on the eradication of prime causes of growing prices, and the overall level of inflation requires strict management, with major deviations from targeted

Table 1. **Overall inflation in various regions and the world as a whole in 2006-2007,** in % per annum

	2006					2007				
	Overall inflation	Food		Fuel		Overall inflation	Food		Fuel	
		Inflation	Share	Inflation	Share		Inflation	Share	Inflation	Share
World figures	3.4	3.4	27.0	11.2	19.9	3.9	6.2	44.3	4.1	8.0
Developed economy countries	2.3	2.0	12.4	11.1	28.0	2.2	3.0	19.5	3.8	12.1
Africa	7.2	8.5	46.6	8.7	22.3	7.4	8.7	43.6	6.7	6.5
CIS	9.3	8.5	40.0	17.1	7.6	9.6	9.2	41.1	11.7	7.2
Asia	3.7	4.4	37.7	12.3	19.4	4.9	10.0	67.5	3.1	3.4
Central and Eastern Europe	5.2	4.6	22.0	9.7	18.2	5.4	8.2	34.9	6.9	11.8
Middle East	3.4	5.1	57.0	1.9	5.3	10.1	13.6	42.3	10.1	24.4

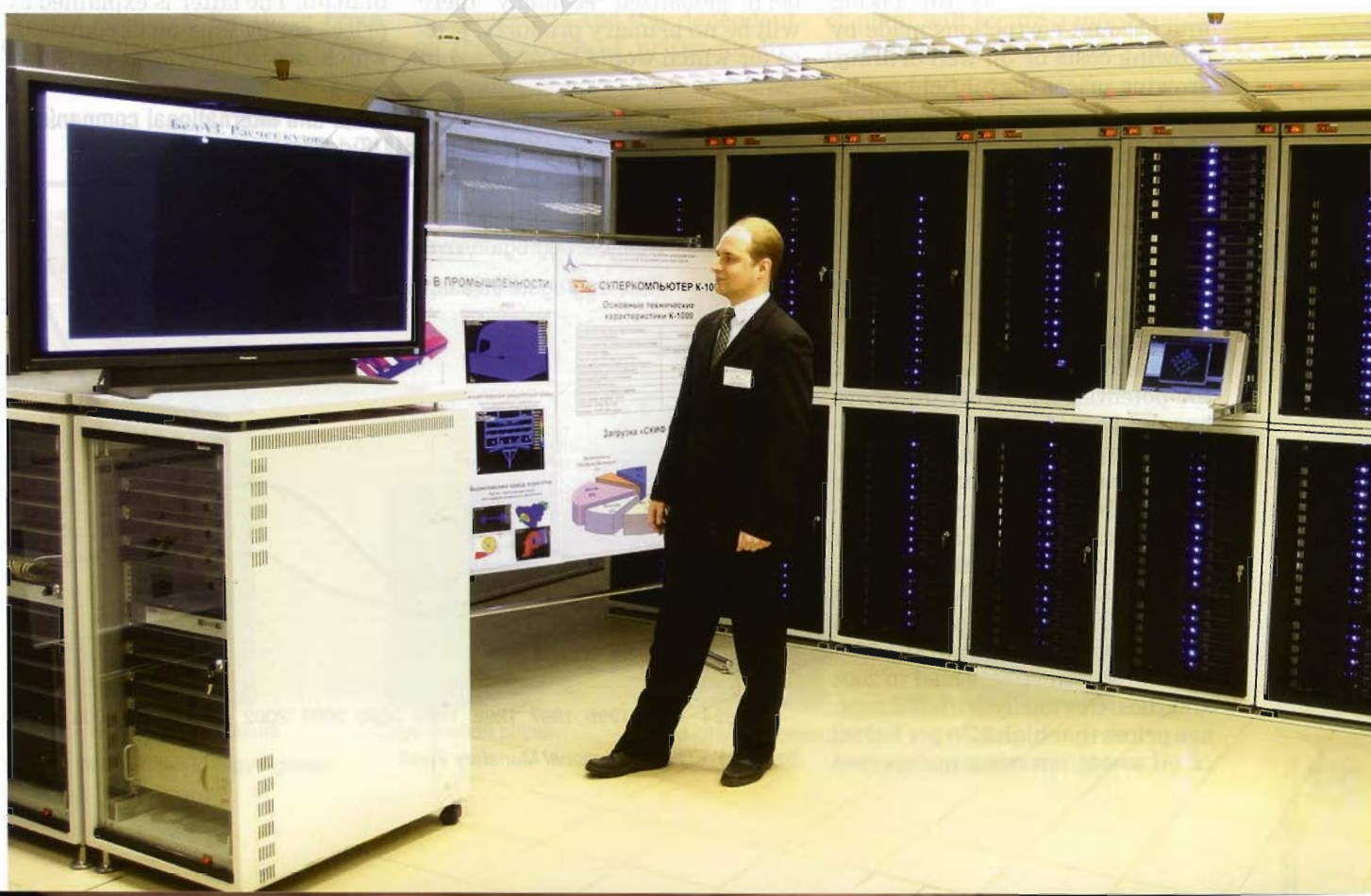
Source: WEO – International Monetary Fund.

parameters avoided. Otherwise expectations of economic agents, including foreign investors, will be formed taking into account conservative appraisal of macroeconomic risks, which will lead to more expensive loans for Belarusian economic entities, lower foreign direct investments and overall economic attractiveness of the country as a whole. Obviously with unstable raw stock markets the achievement of the goal requires not only monetary decisions but structural ones as well within the framework of the entire economic system of the country.

Energy Factor

Between January 2005 and May 2008 the price index expanded by 60%. Prices went up even higher for several commodities critical for Belarus such as oil, natural gas, and iron ore.

Oil is the most expensive energy resource among exchange goods. It is explained by a low flexibility of the demand for oil caused by the lack of substitutes for the oil products that transport industry uses as well as essentially worse geological conditions of oil extraction in new promising fields. In 2004-2006 oil industry



Belarusian-Russian supercomputer SKIF is one of the most powerful supercomputers in the world

Layout of the High-Tech Park, which construction involving foreign investors will begin in Minsk this year

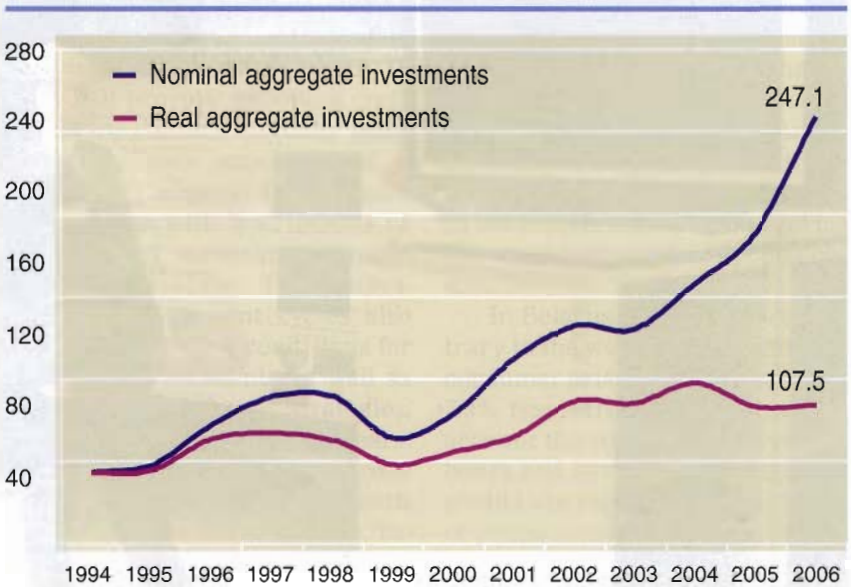
investments grew by some 70% across the globe and approached $250 billion per annum (Picture 1). It means that oil companies respond to the favourable market situation and try to increase their output capacity. But taking into account corrections made by growing costs of oil well drilling, growing prices for oil field equipment, and several other factors an analysis of the same data produces a completely different and unexpected result.

Real investments in the oil industry went up insignificantly and it is vividly displayed by diagrams made using data of the International Monetary Fund and the World Bank (Picture 1). Thus, the potential for higher oil prices has not been depleted and is supported by fundamental factors of supply and demand apart from the profiteering factor (raw commodity futures look more attractively when the dollar is weakening).

According to the IMC forecast model $120 per barrel of oil as the average price lies within the 70% probability range expected in 2008 and 2009. Obviously, with the average prices that high $150 per barrel of oil would not come unexpected for market participants. In view of the factors the government and economic entities should analyse and design their business strategies more thoroughly taking into account the fact that in the modern globalized economy there will be no primary products, prices for which would be reversed in relation to oil prices. The same considerations are applicable to other primary products and food.

Natural gas is a strategic primary product for Belarus in energy equivalent and costs less than oil. The latter is explained by prices set by long-term contracts, which are widely used for Euro-

Picture 1. **Total investments of 53 national and international companies** (in billions of US dollars)



Source: WEO – International Monetary Fund.

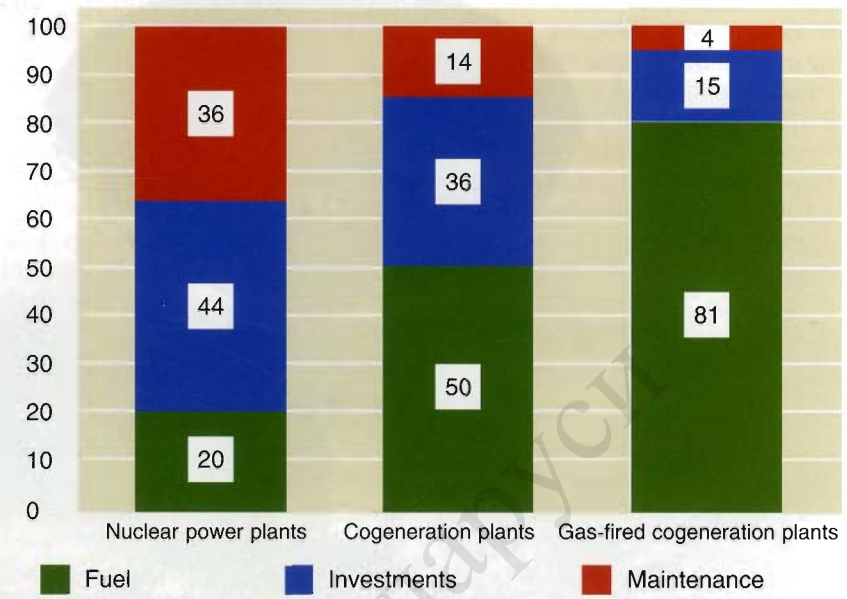
pean Union countries. In May 2008 the prices for Russian natural gas at the German border reached new record high of $428.4 per 1,000 m³ (roughly $70 per barrel of oil equivalent while the average price for Brent oil reached $123.9 per barrel in May).

The last but not the least, coal is the cheapest exchange-traded energy resource, which is roughly twice as cheap as gas and three times as cheap as oil in energy equivalent. Over the last two years coal prices surged by 200%. The figures once again indicate the advisability of implementing an accelerated strategy for diversifying the fuel balance of the Republic of Belarus, introduction of nuclear fuel and probably coal.

Picture 2 demonstrates the structure of power generation costs for various power plants.

Picture 2 shows that fuel accounts for 20% of nuclear plant operation costs, stands at around 50% for coal-fired cogeneration plants and 81% for gas-fired cogeneration plants. On the other hand, specific capital investments (calculated as per kilowatt of installed capacity) are ranked in the reverse sequence for these types of power plants (Picture 3).

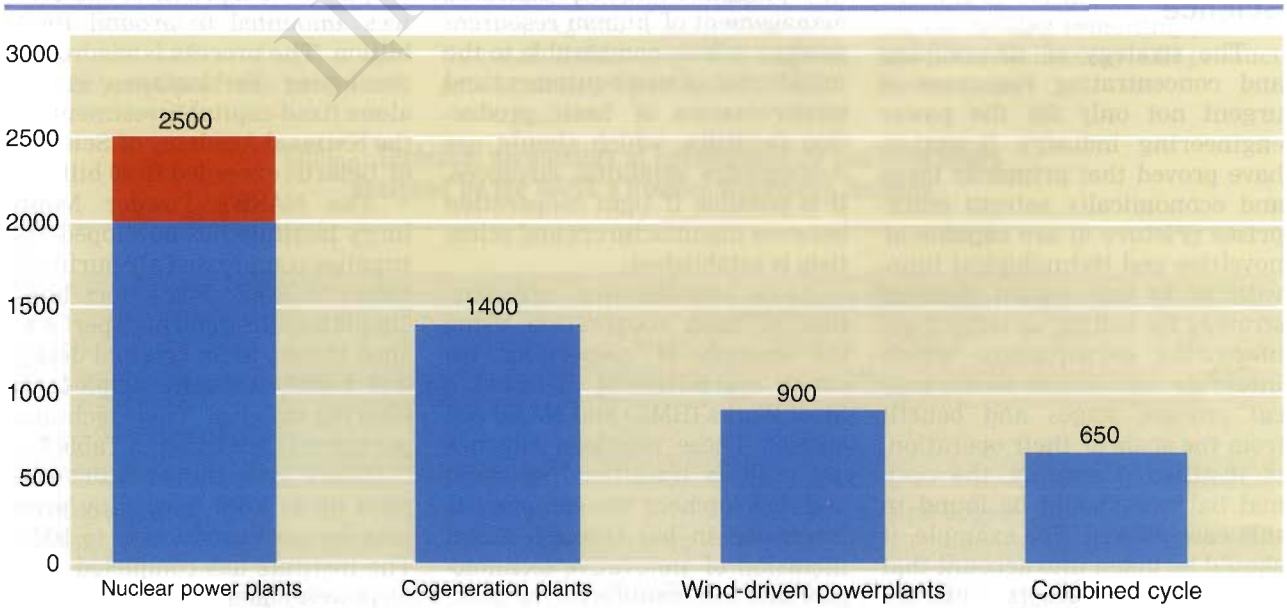
Picture 2. **Structure of production costs for various power plants**



Source: International Energy Agency.

The economic essence is obvious: one has to pay less for fuel during the power plant operation if one invested more in construction. Contrariwise, it is possible to choose a comparatively cheap steam-turbine power plant fired by natural gas and stay dependent on fluctuations of prices for hydrocarbon fuel. The decisions taken by Belarus' leadership are not only a way to avoid energy risks caused by growing oil and natural gas prices thanks to diversifying the energy budget. One-time capital investments in the nuclear power plant will secure a more stable power engineering industry of the

Picture 3. **Specific capital investments for various types of power plants (in US dollars per kilowatt of installed capacity)**



Source: International Energy Agency.

Antenna of the space data centre of the Belarusian Academy of Sciences

country for the next 50-70 years. It is confirmed by assessments of the International Energy Agency: atomic power plants are more profitable for European countries than power plants, which use natural gas or coal, with the gas price over $180 per 1,000 cubic metres and the Coal price over $70 per tonne.

In Cooperation With Science

The strategy of diversifying and concentrating resources is urgent not only for the power engineering industry. Scientists have proved that primarily large and economically solvent enterprises (Picture 6) are capable of novelties and technological innovations. In this regard Belarus' strategy for setting up large manufacturing corporations, which integrate consequent technological process stages and benefit from the scale of their operation, is justified. Certainly, the optimal balance should be found in this case as well. For example, it should be taken into account that only foreign markets, international competition, international manufacturing cooperation and integration can sufficiently stimulate technological advance of major companies.

Sometimes development process is equated to technological innovations. But organisational innovations should not be forgotten. Sometimes the correct organisational structure, well-tuned business processes and sales schemes, management of human resources produce effects comparable to the installation of new equipment and modernisation of basic production facilities, which should use cutting-edge scientific advances. It is possible if tight cooperation between manufacturers and scientists is established.

Let's consider the organisation of such cooperation using the example of cooperation between specialists of Belarusian Steel Works (BMZ) and NASB scientists. These relations advance not only as traditional research and development the company is interested in but through direct inclusion of innovative technologies into the manufacturing process and direct supplies of science-intensive products manufactured by the academic organisations.

The approach became possible five years ago when the Academy of Sciences expanded its operation with research and production. Actually the production of pilot batches and large batches of innovative products by academic institutions is a fact. In 2007 the output of such products and services amounted to around Br250 billion. The process is vigorously developing. For instance, in 2007 alone fixed-capital investments in the National Academy of Sciences of Belarus exceeded Br90 billion.

The NASB's Powder Metallurgy Institute has developed and supplies compressed air purifying filters to BMZ. The filters boast simple handling and high performance thanks to an original design and highly effective triple-layer filtering material. Their technical parameters are listed in Table 2.

Every year the institute supplies up to 1,000 hard-alloy products for cord production to BMZ. The institute has completed long-term development and is ready to manufacture heavy-duty oil sepa-

rators, which boast a high purification degree.

In order to improve the durability of BMZ-made components the Powder Metallurgy Institute has used anodic microarc oxidizing on oxidation coating for functional surfaces of aluminium rollers for straining metal cord (750 rollers per annum). The technology increases the service life of rollers several times and considerably cuts down on foreign currency expenses thanks to import substitution.

Every year the Powder Metallurgy Institute supplies BMZ with over 100 tonnes of hot-rolled zinc anodes of a proprietary design. It is important that up to 30% of the total is made using scrap metal and an innovative technology for manufacturing precise semi-finished anodes via no-pressure die casting. The economic effect of the technology has approached Br1 billion.

For several years the Metal Polymer Systems Mechanics Institute has been using its research and development to supply BMZ with brake pads and friction plates (over 25,000 in 37 titles), which used to be imported. The products are innovative not only for Belarus. More than ten Russian patents were received for the technology of manufacturing environmentally friendly asbestos-free friction materials based on polymer matrix.

For BMZ NASB scientists have worked out and produced a special alloy (0.1% of the heat size), which decreases ingot crystal grains by five times on the average, improving physical and mechanical properties of steel. It is comforting that BMZ specialists have developed a technology for manufacturing and applying modifiers during ingot casting at steel continuous casting plants.

As part of the state scientific and technical programme New Materials and Technologies the Powder Metallurgy Institute has designed a new composite ceramic material, technologies for its milling impulse pressing and baking.

The technology was used to manufacture a pilot industrial batch of rollers, which endurance proved to be high during tests in the BMZ steel wire workshop (hardness HRA – 86-90; ultimate compression strength – 620-624 MPa; ultimate bending strength – 150-156 MPa).

The USA, Japan, France, and China make infrared imaging equipment, but it operates in a wide temperature range, where the high temperature end is surveyed as a rule. As part of the Metallurgy programme the A.V. Lykov Heat and Mass Transfer Institute of the National Academy of Sciences of Belarus is designing a high-temperature infrared imaging solution and a hardware software complex for controlling the temperature and thermal fields in metallurgical production. Specialised high-temperature infrared imagers use components different from traditional ones but the cost of the two types is roughly equal (around $40,000). The project to develop the high-temperature infrared imager is supposed to produce a device, which price will be comparable to that of pyrometric control solutions. The new product is supposed to deliver more information than infrared imaging systems offer. It has been tested in lab conditions, software is being upgraded.

Long-Term Contractual Relations

Although state scientific and technical programmes are important as well as other state scientific programmes, their mechanisms lack a sufficient amount of encouragement for those who develop new technologies as well as those who assimilate them. This is why the Academy of Sciences is dedicated to promoting long-term mutually beneficial contractual relations with companies. In particular, the most interesting projects the Academy and BMZ are implementing include the assimilation of a technology for corrosion resistant and friction-proof coating for steel pipes, development of a technology for manufacturing semi-finished cast sections of rolling equipment using electroslag remelting process and other technology and product innovations.

Table 2. **Technical parameters of compressed air purifying filters designed by the NASB's Powder Metallurgy Institute**

	BMO-60	BMO-120	BMO-300	BMO-1200	BMO-2000
Output, m^3/h	60.0	120.0	300.0	1200.0	2000.0
Air purification degree according to GOST 17433-80	3 class min				
Output dew point, °C, max	-5				
Separation of water drops and steam, %, min	99.3				
Filtering material	bronze, copper				
Shell material	polymer-coated steel				
Size, mm: shell diameter height	230 650	230 800	300 1000	300 1400	300 1800

At present the possibility is being discussed to develop solutions for nondestructive examination of coating thickness of precision molding copperplates and for defect control of solidness and thickness of cast-iron casting rollers. The solution is supposed to increase quality, hence competitive ability and safety of the company products.

For example, these days BMZ uses imported natural fluorite for metal smelting. The Academy of Sciences has developed an original technology for manufacturing more effective and less expensive synthesised fluorite. It is made using fluorine-containing waste left by fertiliser manufacturing processes of Gomel Chemical Plant and natural chalk. The new material will decrease energy consumption and smelting time, as the chemical activity of the synthesised material is higher than that of the natural one. The company will be able to decrease production waste and transportation costs, as the natural material is imported from Transbaikalia and other quite remote areas.

Scientific and manufacturing association Center of the National Academy of Sciences of Belarus designs and manufactures equipment for BMZ (such as grinders, classifiers), which allows extracting free iron (8-12% content) out of slagheaps and making accompanying materials for civil engineering industry and road construction.

The list of the mentioned innovations for BMZ demonstrates cooperation of the Academy of Sciences with a leading Belarusian manufacturer. The list is incomplete. System efforts are exercised in virtually all branches of the economy as part of state scientific research programmes, state scientific and technical programmes and economic contracts. Complete products, which are more or less ready for assimilation in business practices, are presented in the electronic "Catalogue of innovative projects and developments of the National Academy of Sciences of Belarus" or on the website of the National Technology Transfer Centre.

Aiming for Major System Projects

Technological arrearage can entail not only falling competitive ability, but many decreasing macroeconomic indicators, lower living standards of individuals and primarily loss of prospects for the development of a sovereign state.

This is why the assimilation of scientific research is the main way to increase economic and technological safety of a country nowadays. Scientific analysis of the establishment of the so-called new economy indicates that an increase in the integrity of economic security is a key prerequisite for reinforcing the economic security of a state. It is manifested as stronger technical and economic cooperation between enterprises, industry and science, formation of competitive clusters. International experience proves that science and innovations are the key force driving the process. A special term "hi-tech integration" was made up. Do these processes go on in the country? There are reasons to believe they do. Slowly but they do.

With an adequate legislative and organisational support of state administration bodies the unity of efforts of scientific and manufacturing institutions gives a new boost to the development of the national economy. The Academy of Sciences sees a huge layer of issues that have to be addressed. First of all, the policy should be aimed at implementing major comprehensive projects, which provide for an entire range of work from scientific research to the support for the assimilation of new technologies. Scientific and technical services will be effective and in demand when they are comprehensive. It is the projects that the Belarusian industry needs to increase its competitive ability and hence to further enhance the economic security of the country. ■