UDC 338.245(470)
LBC 60.561.38(2Rus)

Russia's defense industry modernization as part of the national idea: learning from history

The article is devoted to the issue of the defense industry complex modernization as a key direction in the strategy of strengthening Russia's national security and ensuring its sustainable economic development, increasing its performance and competitiveness. It analyzes the historical experience of creating and using the science and technology potential of the USSR defense industry.

Defense industry complex, national security, economy modernization, science and technology development, weapons and military equipment, R&D, design and experimental activities, State Armaments Programme.

Aleksey Ye.
NIKOLAYEV
Ph.D. in Economics, Doctoral Candidate at the Department of Economic Theories and War Economics of the Military University of the Ministry of Defense of the Russian Federation
aleksnik.104@mail.ru

In the conditions of scientific and technological progress the tasks and demands of the Armed forces stimulate the production of weapons and military equipment (WME), as well as the wide range of products for consumer and industrial purposes. Regarding modern challenges and threats to the national interests of the Russian Federation, one of the priorities of the long-term military construction programme is technical re-equipment of the army, which should be carried out on the basis of advanced innovation technologies and ensuring the long-term production of the new generation of WME.

Dealing with this task combines, on the one hand, the demands of the RF Military Doctrine and the Armed forces' requirements necessary for their implementation, and on the other hand, the country's economic potential and the state of its military sector. In this regard, particular importance is attached to the level of implementing scientific and technological achievements in the basic sectors of the national economy and defense industry complex (DIC), as well as the ability of the military economic sector to solve successfully the problems of maintaining competitiveness and economic sustainability.

Undoubtedly, complex structure of military production, its scale and diversity, affiliation of goods and services producers to various government departments and different forms of ownership found among them require efficient coordination of management bodies' activities at all levels and coordination of development trends in various sectors of defense economy.

At the same time, special attention should be paid to the issues of strategic planning of DIC development and the search for ways to increase the efficiency of using the resources allocated to the defense.

These issues were discussed at the enlarged meeting of Russia's Security Council on 31 August 2012.

Opening the meeting, President V.V. Putin pointed out the large-scale character of the Armed forces upgrading plans, and noted that our industry, research and design centres, DIC in general should be ready to implement all these plans to the fullest. First of all, it concerns the ability to develop and produce advanced military products with the forward-thinking approach. The funds allocated to the State Armaments Programme and DIC modernization programme should be invested efficiently in order to enhance the country's defense capacity, and develop our technological, scientific and economic base, the Head of State pointed out.

V.V. Putin mentioned the industrialization of the 1930s under Joseph Stalin as an example. "We need to make the same powerful comprehensive breakthrough in the modernization of defense industry, as it was done in the 1930s", the President explained. He pointed out that in the shortest possible time it is necessary to renew the production assets and ensure the priority scientific-technological capacity for the serial production of advanced weapons. "We need to make up for what we lost", V. Putin said. "It is a very difficult task, but it can be and should be solved" [5]. The Head of State made it clear that defense industry modernization should be part of a national idea that can unite the country.

The proposed ideology is dialectically complicated. On the one hand, as V.V. Putin admits, "concerning their technological development, many enterprises remain at the previous century level" and "our defense industry complex has missed several modernization cycles". On the other hand, "defense industry has always been an engine pulling the other branches", so in the coming decade "the unprecedented sum of almost 23 trillion rubles will be allocated to the State Armaments Programme and the DIC modernization programme" [5].

In this connection, it is considered quite important to refer to historical experience of creating and using the scientific-technological potential of the defense industry in order to determine the reasons for DIC lagging behind in a number of areas, the flaws in technological innovations implementation, and in order to find efficient forms of economic interaction between science and production.

It should be noted that the history of the USSR in the twenty years between the end of the Civil War and the beginning of the Great Patriotic War is one of the most interesting and significant periods in our country's modern history. Those were the years when the political and economic system, which lasted until the end of the 1980s, was established. The USSR of that time was in a state of constant confrontation with the majority of developed countries. Such a situation, of course, resulted in the desire of Soviet leadership to create a powerful, which means well-equipped, army.

In those years, this was possible only through the modernization of domestic defense industry in the already existing spheres of military production (artillery, small arms, etc.) and the creation of new branches in the defense industry complex. The circumstances of establishment and functioning of defense industry left their mark on almost all the events of 1921 – 1945 Russian history.

At present, a lot has been written on the subject of industrialization in the USSR, its enhancement in the years of the First Five-Year Plan, and its consequences. In this connection, one should emphasize that in the abandonment of the New Economic Policy and in transition to the command economy the military leaders played a much more significant role than it is generally considered [12, p. 82]. Throughout the 1920s they insisted on the increase of governmental subsidies to military plants, strict planning of military production, centralization of management, submission of civilian branches to the needs of defense sector

and concentration of production in numbered plants. Red Army leaders in their speeches and reporting notices constantly reminded of the necessity to accelerate industrialization as a factor of the country's military power expansion given the hostile relations between the USSR and many other countries.

The beginning of 1930s was characterized by the surge of aggressiveness on the part of imperialistic states, which made the prospect of a new world war even more tangible. In the current situation the defense complex modernization was considered as a necessary condition for the survival of the USSR in the face of a military threat from the outside.

In this rather complicated state of affairs, in February 1931, J. Stalin delivered a speech "On the tasks of economic executives". He said, "One should have a passionate Bolshevistic desire to handle the machinery, to master the science of production." The entire history of Russia indicated that "it was beaten because of its backwardness" and first of all – military backwardness. "Do you want our socialist Homeland to be beaten and to lose its independence?" Stalin asked. "We are lagging behind the advanced countries by 50 – 100 years. We have to cover this distance in 10 years. Either we do it, or we'll be crushed" [13, p. 38]. If in 1930, according to Stalin, industrial growth was 25%, then a completely unrealistic target of 45% was set for 1931 which concerned primarily the defense objects.

In the 1930s, in fact, such branches as machine-tool industry, precision engineering and instrument making, chemical, power engineering, tractor and automotive industry were created anew. This provided the means of production for such branches of defense industry, as aircraft and tank production, artillery and small arms production, surface and submarine vessels production.

Gradually the defense sector turned into a vast branch of industry, which, according to some estimates, accounted for 9 – 10% of the annual gross income of the country already in the late 1920s – early 1930s, and by the end of the 1930s, this share reached 30% [9, p. 35].

In 1936 and 1937 the Soviet military industry began a new stage of advanced foreign technologies development, the demands to the quality of manufactured products increased. Aircraft industry, the production of arms and ammunition apply such methods as hot stamping, casting, cold pressing and other set-up operations, increasing the accuracy and smoothness of parts processing [11, p. 104].

The production of the main types of WME steadily increased. The total volume of industrial production in the USSR increased 2.2-fold, and the defense products production – 3.9-fold in the period of the Second Five-Year Plan (1933 – 1937). The average annual production of planes and tanks for 1935 – 1937 increased 4-fold in comparison with 1930 – 1931 period, artillery tubes production – 2.6-fold, rifles – almost 2.3-fold [14, p. 95].

In those days, the defense industry indeed became an "engine" of not only industrial, but also economic development of the country as a whole. The demand for technologies in weapons creation "forced" the development of civilian industries. The country faced an increase in the production of coal, oil, cast iron, steel, and the generation of electricity.

Approximately a 7-fold increase in the gross industrial output for only 11 years, and a 15-fold increase in comparison with the pre-revolutionary level, achieved without foreign financial and resource support, speak for themselves [8, p. 65]. One should only add that it concerns, first of all, the development of the high-tech industries.

This ensured the country's technological independence on the eve of dramatic armed clashes. The data in *table 1* illustrate the general nature of the changes, justly viewed by contemporaries as revolutionary and successful.

Table 1. Dynamics of the share of import in the USSR domestic consumption as an indicator of the country's technological independence, in % [8, p. 65]

Types of production	1913	1927/28	1937
Mechanical engineering production	43.6	30.4	0.9
Tractors	-	63.4	0
Automobiles	100	68.2	0
Rubber	100	100	23.9
Superphosphate	63.1	28.0	0
Aluminum	100	100	4.9
Watches	100	100	2.3

Simultaneously with the strengthening of the scientific and technological potential and the creation of extended military production, the activities were undertaken on the preparation of national economy to military restructuring and enhancing its vitality. The second defense industrial base was established at a quick rate in the area of the Volga region, the Urals, Siberia, defense enterprises were constructed in the Russian Far East.

The main result of the country's pre-war industrial development was the opening of 2,900 new plants, factories, power plants, mines, collieries and other industrial enterprises, most of which to a certain extent worked for the defense. At the same time, the development pace of the defense sector exceeded that of the other sectors. So, the annual output of the entire industry grew by 13% on the average, as for the defense production, its output increased by 39% [9, p. 36].

Naturally, the intensification of the defense industry development demanded the creation of special supervising bodies. The Order of the Supreme Council of the National Economy (VSNKh) dated 4 December 1925 No. 164 established the Military-Industrial Agency under the VSNKh Presidium for the general supervision over defense industry activities on the basis of committees for mobilization and demobilization of industry and military orders. As for the state association Glavvoyenprom (Chief Directorate for Defence Industry), it was transformed into the Industrial Association for Defense Industry (Voyenprom), retaining its functions of direct management of the enterprises.

Thus, the transition to industrialization and creation of sectoral associations in the industry revealed itself firstly in the military production. In 1937 the People's Commissariat of Defense Industry was established.

Due to the great work on the establishment of a powerful economy, the development of defence industry and the army that was carried out in the pre-war years, the USSR ranked first in Europe and second in the world by the volume of industrial production. Encyclopedia Britannica evaluates the results of industrialization in the USSR as follows, "In 10 years the USSR actually worked its way up from one of the backward states to the great industrial power; this was one of the factors that ensured Soviet victory in World War II" [16, p. 302-303].

Achievements of the national economy were inextricably linked to the development of science. The Soviet government took active measures for coordinating scientific work in the whole country. Branches of the USSR Academy of Sciences appeared, the number of institutions in the system of the USSR Academy of Sciences increased from 28 in 1932 to 48 in 1937, and the number of their staff increased 2.6-fold. There were 806 research institutes and their branches in the USSR by the end of 1937 [6, p. 86].

The country had a significant potential for handling fundamental theoretical problems, as well as applied, practical issues connected with the tasks of strengthening the defense and increasing the combat power of its Armed forces. Great progress was achieved in the study of physical properties and chemical structure of metals and alloys, sources of energy and raw materials. Soviet mathematics and physics produced major scientific achievements as well. The number of those having important practical value include the discovery of the combinatorial scattering of light by Academicians L.I. Mandelstam and G.S. Landsberg; the achievements in the field of physical phenomena taking place at temperatures close to absolute zero. The research by Academicians N.D. Papaleksi, A.A. Andronov, N.M. Krylov had important theoretical and practical value for the development of radio and mechanics. The studies of Academician A.F. Ioffe in the physics of semiconductors opened new horizons in the field of electrical materials [6, p. 87].

Numerous scientific discoveries shaped the perspective directions in the development of military equipment. The 1930s already witnessed a series of fundamental works on the nuclear structure theory, radioactive decay, search for more advanced principles of subatomic particles acceleration, etc. The method of studying ultra-rays and processes of nuclear decay in a strong magnetic field, developed by D.B. Skobeltsyn, served as the basis for the discovery of positrons, neutrons and other subatomic particles constituting the atomic nucleus. Soviet physicists V.A. Fok, G.A. Petresh, G.N. Flerov, Yu.G. Khariton, Ya.B. Zeldovich made a great contribution to the substantiation of the process of uranium fission chain reaction.

The works in the field of jet propulsion went on successfully as well. For their consolidation, the decision is made in April 1933 on the establishment of the Rocket Research Institute, which played an important part in the study of the problems of jet propulsion and rocket and missile engineering.

The achievements of the economy, science and technology have allowed a most difficult problem in the sphere of military construction to be handled, which was the creation of new armament types and the establishment of their serial production.

However, when solving specific tasks related to the technical rearmament of the troops, the state met with serious difficulties in the beginning.

First of all, there was a shortage of qualified engineering personnel. Therefore, according to the direction of the Central Committee of the All-Union Communist Party in the first half of the 1930s, specialized research institutes, design bureaus and testing production facilities were founded, which launched the creation of advanced WME. As a result, the number of engineers-designers from 1936 to 1939, in aircraft design bureaus for instance, increased from 1370 to 3166 people [3, p. 183]. In this period the design bureaus headed by A.I. Mikoyan, S.A. Lavochkin, P.O. Sukhoy were established.

It should be noted that the system of organizing R&D in the pre-war years was well-adapted to functioning in emergencies. The Great Patriotic War showed it most clearly. The rigid vertical management structure made it possible to review the research directions in no time and to focus the efforts on solving the key problems in the sphere of defense. So, the Academy of Sciences was able to complete this work in just a few months despite the great difficulties connected with the evacuation of academic institutions to the east.

From the very first days of the war the work of the research institutions of the Academy of Sciences was reorganized to meet the demands of the defense sector in the major directions: modernization of series-produced weapons and military equipment, creation of advanced weaponry with improved or completely new

combat characteristics and also the provision of tangible support to the defense industry in the development and implementation of advanced technologies. The State Defense Committee (GKO) and the Council of People's Commissars engaged the USSR Academicians I.P. Bardin, B.E. Vedeneyev, S.I. Vavilov, A.V. Vinter, P.L. Kapitsa, A.Ye. Fersman, A.N. Bakh, A.A. Blagonravov and others. A special commission on scientific and technical issues under the chairmanship of Academicians A.F. Ioffe and I.V. Kurchatov was established to deal with the issues concerning the use of scientific achievements for the needs of the front [6, p. 157].

At the same time, the priority importance of defence issues didn't imply the cessation of fundamental research. The top-priority basic research went on alongside a great scope of activities aimed at creating and improving weapons and military equipment, development of new technological processes, search for and development of mineral deposits. Thus, in the end of 1942, GKO decided to resume the research on uranium, which was aimed at the creation of an atomic bomb. And in February of the following year, the first scientific-research institution (Laboratory No.2 of the USSR Academy of Sciences), headed by I.V. Kurchatov was opened, which dealt with nuclear issues. Continued work, including the creation of jet engines, provided a reserve for the future, and immediately after the war it promoted a new stage of technological development in our country.

It should be noted that at the same time, Nazi Germany decided to stop the financing of any R&D, which didn't produce the result within six months [1, p. 45].

The war promoted the strengthening of centralization in the leadership of the scientific-technological sphere. Under the supreme power body, the GKO, a special position of the Commissioner for Science was established, besides, the Scientific-Technical Council was formed, which included prominent scientists, representatives of industrial ministries and the military. The Council coordinated the research on the most important scientific and technical issues, organized the work on defense issues. But in general, the activities of the GKO Commissioner for Science along with its subordinate structures became the first experience of establishing inter-sectoral cooperation on the national scale.

The conditions of war demanded other changes in the forms of scientific activity organization. Thematic and integrated commissions became widespread in the system of academic science. The Council for Scientific and Technical Examination at the State Planning Committee (Gosplan) of the USSR played an important part in the planning of scientific-technological support to the war economy. It is noteworthy, that in 1945, 20 out of its 26 members were the representatives of the Academy of Sciences. Similar structures in the form of scientific-technical councils were established under the republican Gosplans and people's commissariats. A number of R&D and project-design organizations functioned at large aircraft, tank, ordnance, and other plants.

The development of defense production was characterized not only by quantitative indicators, but also by profound structural changes, connected with the development of new forms and types of armaments, enhancement of tactical and technical characteristics of weapons, improvement of technological processes in defense plants. In the three years from May 1942 to May 1945, labour productivity in the industry on the whole increased by 43%, and in defense branches – 2.2-fold [9, p. 39]. In many ways this was the result of the new technologies introduction and labour organization improvement. Growth in labour productivity ensured a reduction in the cost of living labour per unit of products *(tab. 2)*.

Besides, the costs for the production of major weaponry were significantly reduced. In 1944, the cost price of all types of military products in comparison with 1940 decreased 2- fold in average *(tab. 3)*. Ultimately, the cost of military products for 1941 – 1945 was reduced by 50.3 billion rubles that was equivalent to the war costs in the period of 150 days [9, p. 40].

During the war, Soviet industry constantly updated the samples of the arms produced and supplied to the troops. As a result of the efforts of designing and engineering personnel and ordnance and rifle industry, small arms were updated by 80% and the ordnance park – by 85% by the end of the war; the rest of the artillery systems were substantially upgraded. Armored industry produced more sophisticated tanks and self-propelled guns. In the course of the war, the serial production of 25 new models of aircraft (including modifications) and 23 types of aircraft engines was launched [2, p. 51 – 52] .

In the years of the war, the factor of time was of crucial importance, the ability in the shortest time to develop new weapons and organize their serial production. For example, the new 152 mm howitzer D-1 was constructed in 18 days. And its mass production was launched in 6 weeks. Self-propelled guns were created on the basis of serial tanks and guns, for example SU-122 on the basis of T-34 tank and M-30 howitzer, ISU-152 on the basis of IS and a 152 mm howitzer gun.

On the whole, the USSR defense industry produced 19.75 million units of small arms, 490 thousand guns, 136 thousand aircraft, 102.5 thousand tanks and more than 8 million tons of ammunition [9, p. 39].

It should be noted that in the years of World War II, the USA significantly expanded the scope of R&D in the defense sphere as well. The Manhattan Project, the research and development programme for creating an atomic bomb became an important landmark in the

Table 2. The cost of labor at the enterprises of military industry (thousand man-hours per unit) [7, p. 114]

No.	Item	1941	1943
1.	Il-4 aircraft	20	12.5
2.	Il-2 aircraft	9.5	5.9
3.	Pe-2 aircraft	25.3	13.2
4.	KV tank	14.6	7.2
5.	T-34 tank	8	3.7
6.	152mm howitzer-gun	4.5	2.4
7.	76mm regimental gun	1.2	0.8
8.	76mm divisional gun	2.2	0.6
9.	Heavy machine gun	0.642	0.329
10.	7.62mm rifle	0.012	0.009
11.	Cartridges for TT pistols (1000 pcs.)	0.013	0.0108

Table 3. Cost of some types of weapons and military equipment (in thousand rubles per unit) [4, p. 40]

No.	Item	1941	1942	1943	1944
1.	Il-4 aircraft	800	468	380	380
2.	Li-2 aircraft	650	510	424	424
3.	Pe-2 aircraft	420	353	265	265
4.	KV tank	635	295	225	-
5.	T-34 tank	269.5	193	135	135
6.	122mm howitzer-gun M-40	94	39	35	35
7.	PPSh submachine gun	0.5	0.4	0.14	0.148
8.	7.62mm rifle	0.163	0.12	0.1	0.1

history of using science for military purposes. The programme pulled together the immense scientific, production, material and financial resources. The major works were performed in 1942 – 1945.

The creation of an atomic bomb revealed the tremendous potential of modern science and technology, demonstrated the ability of large teams of scientists and engineers, supplied with appropriate material and financial resources, to achieve crucial results in the short term.

The Second World War led to the profound revolutionary transformations in the world. First of all, the geopolitical standing of the Soviet Union strengthened considerably, its moral authority increased and its position in interstate relations improved. Another outcome of the war was the U.S. aspiration for becoming the world ruler. Only the USSR could challenge those ambitions. This meant the emergence of two superpowers on the international arena – the USA and the Soviet Union with fundamentally different interests and views on the world order, which created a firm basis for conflicts and direct confrontation.

The Cold War was also spurred by the revolution in defense and technology. It was marked by the emergence and rapid improvement of new arms, including missile and nuclear weapons, jet aircrafts, space-based assets, etc. That required radical transformations in the defense-economic sphere, creation of new military-industrial facilities, innovation R&D base, organizational and management systems complying with the new requirements.

In these conditions, the inequality in the development level of the anti-Hilter coalition leading member-states increased even greater. The economic power of the United States was supported by their monopoly on nuclear weapons, which made the overwhelming superiority of the USA over the USSR even more threatening, and in the case of direct military conflict between the superpowers, this might have disastrous consequences for the Soviet Union.

Taking into account the trends in the development of arms, only the possession of nuclear weapons and the means of their delivery would ensure the USSR – U.S. strategic parity to some extent. At the same time it was necessary to protect the main centres of the country from a possible nuclear attack. For these purposes, the Soviet government directed its special attention to the issues of nuclear energy, creation of an atomic bomb, development and production of missiles and the deployment of an air defense system capable of repelling a mass nuclear attack.

It is noteworthy that this task was unprecedented according to its scope and organizational complexity. First of all, the newly established production facilities required enormous resources. And there existed no other options, but their redistribution at the expense of other sectors, of the consumer sector, in particular. [1, p. 73].

Another innovation envisaged the boosting of the Soviet Union's own R&D. The nuclear power industry, rocket and missile production, radio-electronic industry are extremely science-intensive sectors. Therefore, their establishment and successful development depends on the regular input of basic research achievements.

However, the idea of relying on foreign R&D as the main source of innovations was obviously futile. Choosing the foreign scientific achievements caused the delay in their implementation. Besides, at any time, they could become inaccessible. Therefore, in the development of the new types of weapons, a decision was made to create the research-and-production complexes based on the country's own fundamental and applied R&D.

The research carried out in the pre-war years and the years of the Great Patriotic War influenced the solution of these problems greatly. It concerns, first of all, the progress in nuclear engineering and jet engine building.

These two spheres in many ways predetermined the evolution of not only the means, but also the forms and methods of military struggle. R&D achievements in the sphere of nuclear power enabled the test of the Soviet Union's first atomic bomb already in 1949, and in 1953 – the world's first thermonuclear device. Civil nuclear energy was also developing: the world's first nuclear power plant was launched in the city of Obninsk in 1954. The "Lenin", the world's first icebreaker with a nuclear power unit was built in 1957.

The development of jet engine building facilitated the emergence of jet aviation and, what is most important, the creation of ballistic missiles. All this led to the development of national missile-borne nuclear weapons (MBNW), that still remain the main deterrent to a possible aggression. The intensive development of MBNW, jet aviation, nuclear submarines, space-based systems and other types of WME influenced the related fields of science and technology, which, in general, promoted progressive scientific and technological advance of our industry and country on the whole.

It is necessary to mention the increased number of scientific and engineering establishments, engaged in R&D projects implementation. After the successful test of the first atomic bomb the Secretariat of the Special Committee prepared a paper, which listed the institutions and organizations, which dealt with the "problem number one". It contained 29 "main" institutes and design bureaus, where over 20 thousand people were engaged in "special research", including about 1.5 thousand scientific associates and over 5.5 thousand engineers and technical staff [1, p. 86].

In addition to the "main" establishments, about 50 other institutes and design bureaus of the Academy of Sciences of the USSR, Academy of Medical Sciences, various ministries and departments participated in the nuclear project.

They solved the single scientific and technical tasks, set by the "head" organizations. And with the creation of the first atomic bomb, the scale of attracting scientific resources to the work on the "problem number one" by no means decreased. On the contrary, it was significantly expanded. Nuclear capacity build-up rates set by the government, did not allow any other option. And now the emphasis was placed on implementing the national achievements. Copying American R&D became a thing of the past. In some cases the USSR even managed to surpass the former "teachers".

This was exactly what happened in the case of a hydrogen bomb. The USSR government adopted the decision on its creation in February 1951, a year later than the U.S. [14, p. 206]. The USSR – U.S. contest in the area of hydrogen weapons became a kind of "intellectual" arms race, the first one in the history of mankind. The creation of atomic weapons implied the necessity of dealing with engineering issues first of all, of organizing large-scale work in the mines and factories, as for the development of a hydrogen bomb, it led to the emergence of new directions in science – physics of high-temperature plasma, physics of ultra-high energy densities, physics of abnormal pressure.

It was the Soviet Union that won this "battle of brains". A hydrogen bomb was dropped from a Tu-16 aircraft on 6 November 1955. In the USA the release of a hydrogen bomb took place only on 21 May, 1956.

The rise of radioelectronic industry resulted in the serial production of state-of-the-art equipment for air defense systems of Moscow. In May 1953, the first stage of the missile firing tests with radio-controlled aircrafts as targets was successfully completed, and two years later the air defense system was put into operation [1, p. 96]. It was then upgraded many times thanks to its functional reserves; at that, the changes in the strike aircraft of the U.S. strategic aviation were taken into account. The life cycle of the system exceeded 30 years.

The obsession with the need to achieve military superiority over the Cold War rival manifested itself in huge government expenditures on the development and production of more sophisticated military equipment, in the creation of appropriate technologies, which, after some time, entered various segments of the civil sector (nuclear power engineering, communication technology, computer, satellite technologies, etc.). As a result, these "war" technologies introduced in the civil segments of the world market economy created a variety of multiplicative effects, which led, in particular, to the emergence of new "technological modes" [15, p. 54].

Thus, the transition from ultra-high frequency physics to quantum-electronic physics was marked by the creation of an essentially new class of devices. Masers, or variable-parametric amplifiers were developed for improving radar equipment as high-sensitivity receivers with a low level of self-noise for early strategic warning systems. Their creation was preceded by the development of lasers, widespread at present, the role of which is also significant in the plans of creating space-based military complexes within the "Star Wars" programmes. It is worth recalling that lasers and masers are the fruits of fundamental science, acknowledged in 1964, when the Nobel Prize was awarded to N.G. Basov, A.M. Prokhorov and C. Townes for the outstanding achievements in the field of quantum radiophysics.

Theoretical and technological results, obtained in the course of radar development, facilitated the establishment of radionavigation, radiospectroscopy, radiometeorology and many other scientific and applied fields, including radar astronomy. This most ancient natural science witnessed radical changes in its tool base that led to important discoveries, including quasars (1960), cosmic microwave background radiation (1965) and pulsars (1967) [10, p. 281].

It is the needs of the Cold War that brought to life new "technologies of creating new technologies", which are sometimes called innovation-design technologies. In this period, the Manhattan Project technology type was used systematically for achieving, first of all, the military-strategic goals. A brightest and most well-known example is the U.S. programme Apollo dedicated to landing a man on the Moon, as well as Reagan's Strategic Defense Initiative.

It should be emphasized that in the USSR the tasks of maintaining the military-technological parity with the USA and NATO were solved in similar ways. Our country possessed the corresponding programme and design technologies of innovations creation, large-scale technological breakthroughs were achieved.

Despite serious flaws in organization and management of the military economy at the top level (wrong strategy of military confrontation with the West adopted by the Soviet government, excessive secrecy, lack of mechanisms providing the spread of advanced technologies, created for military purposes, to the civilian sector, etc.), the Soviet Union, due to the efforts of scientists, engineers and defense industry manufacturers, launched the first satellite into space, opened the era of manned space exploration, established many world records in aviation and ensured other achievements, contributing to the glory of the Homeland.

At the peak of their development, the military industrial complex enterprises were the most advanced ones in the Soviet industry in terms of technologies and organization. They accumulated the most part of the country's scientific and industrial potential. Due to the fact that, at present, defense-industrial complex remains the leading high-tech sector of Russian industry, it can still be the "engine" of Russia's renewed economy in the 21st century.

Thus, the analysis of the defense industry development and modernization in the first half of the 20th century, allows a number of conclusions to be drawn.

Firstly, given the serious complications in the 1926 – 1927 foreign policy of the USSR, the economy industrialization was regarded as a national idea that would facilitate the country's uniting, its overcoming the backwardness in the military, cultural, governmental, industrial spheres, would set the general trend of further development, and strengthen the country's defense capability.

Secondly, a comprehensive approach to the formation of industrialization strategy in the conditions of centralized planning allowed the set tasks to be solved in the shortest possible period for the first time ever. At that time, the Soviet Union shifted from the "catching-up" to the "outrunning" type of development and joined the ranks of world leading countries.

Thirdly, the intensive development of armaments was to a great extent determined by the efficiency of ordering bodies, people's commissariats and chief directorates, design bureaus and serial production plants, the initiative and search for out-of-the-box solutions; furthermore, a new constellation of designers emerged, and modern weapons bear their names.

Fourthly, of crucial importance in the defense industry modernization, especially in the war period, was the viability of the state and military management system: the ability to manage and the governability of the organizational structures themselves in the most complicated state of affairs.

Fifthly, the defense industry reacted swiftly and flexibly to the demands of the army, to the defects revealed in operation, it allowed the basic types of armament to be promptly updated and adapted to the combat conditions.

Sixthly, the continuity of scientific research ensured a constant inflow of theoretical achievements to design bureaus and industrial enterprises. Science was to the fullest extent close to production, to practice, to the assessment and analysis of the experience of using weapons and military equipment on site.

Seventhly, the continuous increase of scientific-technological potential not only in the fields directly connected to WME creation, but also in the related ones, for example, in medicine, biology, quantum physics, helped to create a new structure of industrial sectors, including the branches of new "technological modes".

Taking into account the historical experience, it won't be an exaggeration to say that the present course toward the defense industry modernization is a tangible opportunity for Russia to handle the tasks of national importance: the enhancement of Russia's status as a world power, promotion of sustainable economic development, increase of its efficiency and competitiveness. In this regard, providing support to the defense-industrial complex for the perspective of gaining technological innovations is an important guarantee of Russia's national security. Moreover, it may be the emerging new technologies, on which Russia should pin its hopes for overcoming the crisis of the early 1990s, its hopes for establishing itself a full-fledged participant in the world economy.

We think that today the state of the economy and the expectations of Russian scientific community are quite favourable for further reforms on the defense industries modernization. The unprecedented scale of the State Armaments programme and DIC modernization programme confirms the seriousness of government's intentions. In turn, one should hope that the government has enough will and political tools for the comprehensive implementation of declared plans.

References

1. Artemov Ye.T. Scientific-technical policy in the Soviet model of late-industrial modernization. Moscow: ROSSPEN, 2006.
2. Bartenev S.A. Economic confrontation in the war. Moscow: Voyenizdat, 1986.
3. Bystrova I.V. Soviet military-industrial complex: problems of formation and development (1930 – 1980). Moscow: IRH RAS, 2006.
4. Veshchikov P.I. Everything for the front! Everything for the victory! Or the military-economic factor of the victory in the Great Patriotic War. Bulletin of the Academy of Military Sciences. 2005. No. 3 (12). P. 35 – 43.
5. Vladimir Putin held an enlarged meeting of Russia's Security Council. Available at: http://kremlin.ru/news/16328
6. Kiryan M.M., Babakov A.A., Bazhenov A.N. Military-technical progress and the Armed Forces of the USSR (the Analysis of development of armaments, organization and methods of action). Moscow: Voyenizdat, 1982.
7. Voznesenskiy N. The military economy of the USSR in the period of the Great Patriotic War. Moscow: OGIZ, 1948.
8. Mindeli L.E., Khromov G.S. Scientific-technical potential of Russia. Part 1. Moscow: CSRS, 2003.
9. Moskovskiy A.M. Defense industry and its contribution to the Victory. Bulletin of the Academy of Military Sciences. 2005. No.2. P. 35-42.
10. Science and security of Russia: historical-scientific, methodological, historical-technical aspects. Moscow: Nauka, 2000.
11. Simonov N.S. The military-industrial complex of the USSR in 1920 – 1950s: economic growth rate, structure, organization of production, management Moscow: ROSSPEN, 1996.
12. Sokolov A. K. "A special tension": personnel of the Soviet Voyenprom in the late 1920s – early 1930s. Otechestvennaya istoriya. 2007. No. 4. P. 74-94.
13. Stalin I.V. On the tasks of economic executives: a Speech at the First All-Union Conference of personnel of socialist industry on 4 February 1931. In: Stalin I.V. Writings. Vol. 13. Moscow: State Publishing House of Political Literature, 1951. P. 29 – 42.
14. Faramazyan R.A., Borisov V.V. Transformation of the military economy in the 20th – the beginning of the 21st century. Moscow: Nauka, 2006.
15. Chernoy L. Wars as a factor of global economic transformation: retrospective and present time. Russian economic journal. 2002. No. 8. P. 53-65.
16. Encyclopedia Britannica: A New Survey of Universal Knowledge. V.21. Chicago. London. Toronto. 1966.