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**Global Challenges and Prospects of the Modern Economic
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**TECHNOLOGY TRANSFER IN THE ENERGY SECTOR:
EXPERIENCE OF INTERNATIONAL COOPERATION**

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Abstract

Increased attention to the process of creating and implementing innovations makes it relevant to study effective approaches to technology transfer. The content of the transfer is considered by the authors at the level of international exchange of knowledge, technologies, and information. In this article, we studied the experiences of intercountry technology transfer in the energy sector. Technological challenges of the XX-early XXI centuries form new approaches to the use and production of energy resources. A unique project of the twentieth century is the GOELRO (transliteration of the Russian abbreviation for "State Commission for Electrification of Russia") plan, adopted in Soviet Russia in 1920. This program set the trend for the creation of a global energy system in the USSR. The authors of this study focus on the first stage of the scientific and technological revolution, which is characterized by convergence in the field of energy development to address global issues of development and application of energy in the world. Political tensions during the cold war, on the one hand, limited the implementation of interstate projects, on the other hand, competition increased the quality of studies. Based on the studied archival materials, conclusions are drawn about the institutional, organizational, and economic components of technology transfer. The unique experience of interstate cooperation during the construction of the Aswan dam was studied. The mechanism of interdepartmental interaction is shown, the stages of the innovation process and technology transfer in the development and implementation of the Aswan dam project are identified.

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1. Introduction

The modern industrial revolution is making fundamental changes in the nature of economic, social and political life. Against the background of transformation, energy continues to play a decisive role in creating a new communication infrastructure. According to modern scientists, the creation of horizontal interactions is based on eco-friendly approaches to electricity generation (Rifkin, 2017). In many ways, the existing energy industry, by inertia, is based mainly on vertical interactions, where public policy plays a decisive role.

The global energy project of the twentieth century is created in 1920 State Commission for Electrification of Russia (GOELRO) headed by Krzhizhanovsky. The starting points of each period of development of the GOELRO plan were the reorganization of science under the influence of technological challenges of time. Dynamic jumps or distances of 50-60 years in length, according to the theory of "long waves of conjuncture" by Kondratev (2002), stimulate revolutionary innovations, devaluing the invested capitals. For example, the energy industry has repeatedly undergone profound changes in the period from 1920 to 2020, especially in the context of the global energy crisis of 1973. Currently, discussions about global energy issues are driving a wave of investment in new ways of generating electricity. Nuclear power plants are being shut down, particularly in Germany (Fuks, 2016). Coal thermal power stations (TPS) are being replaced by solar panels.

Interstate cooperation on energy development was somewhat difficult in the conditions of the cold war between the USSR and capitalist countries. However, international projects implemented in the 1950s and 1960s indicate a large-scale technological transfer in the world, including with the participation of Soviet engineers and scientists.

Technology transfer, being a rather difficult type of communications, is designed to perform a specific task. Implementation of the transfer can include a process from scientific development to innovation creation. At the same time, the most important role is played by the conditions of interaction between the subjects of the innovation process. The problem of technology transfer is too specific in different institutional conditions (Solentsova & Kapitonov, 2019; 2021). Therefore, in each individual case, it is necessary to design an individual approach to technology transfer that is adequate to institutional, organizational, and intellectual resources. It is also quite obvious that it is impossible to repeat past experience in such a rapidly developing field as the research sector. Meanwhile, systematization and research of the experience of international contacts in the field of energy, traditions of this level and scale, based on unique documentary sources, allows us to form an idea of the nature and content of the transfer and serves as a very productive context for studying the world economy. This is all the more relevant because the history of interstate interactions in the area under study has yet to be rethought.

2. Problem Statement

The problem of studying technological transfer between states is the lack of a unified approach to the study of transfers. The nature of technology transfer can be very diverse. To date, there is no single definition of the concept. This can be an organized process of transferring or attracting knowledge, experience, and methods developed by one party. The relationships can be secured through legal

agreements. Under the transfer is proposed to understand the system of relations between agents of public exchange about the transfer of profitable knowledge. The most important problem for us is to understand the process of adaptation of technology and its effectiveness. To solve our scientific problem, the most important role is played by subjects, participants of the transfer. Is the transfer justified? Can technologies and ideas be implemented in the new environment?

3. Research Questions

One of the research objectives is to analyze promising technological solutions in the field of energy in the USSR, the USA, Canada and other countries in the 1950s and 1960s. The study of shifts in the industrial structure of the USSR against the background of world electrification rates in the context of the technological revolution of the second half of the twentieth century is very demonstrative. Identification of the main parameters of interstate cooperation of the USSR in the field of energy technology transfer is a task that is solved by studying the activities of a number of research institutes. As a technology transfer under the GOELRO plan, one of the most significant examples is the development and implementation of the Aswan dam project. The study of the nature of the concluded agreement between the UAR (United Arab Republic) and the USSR against the background of existing political tensions in the world is another research task. The materials of the Russian state archive, which are the most valuable documents on international cooperation and technology transfer, are involved in scientific circulation. In addition to the management documents studied, the authors analyzed the correspondence of scientists on the problems of energy development.

4. Purpose of the Study

The purpose of this article is to study the experience of international cooperation in the field of energy. Analysis of documentary sources contributed to the achievement of this goal. Normative documentation, interdepartmental orders, statistical data, personal correspondence of scientists are representative sources for analysis. Due to its specific nature, the study is not strictly limited to territorial boundaries. To analyze the problem of technology transfer, we used data on countries (USSR, USA, UAR, France, etc.) within the chronological boundaries of the studied period. The authors consider the study of the institutional and organizational components of international contacts as an opportunity to analyze the specifics of transfer under the conditions of vertical managerial interactions. Therefore, a multi-pronged approach to problem research allows to achieve this goal.

5. Research Methods

The comparative-historical method, combined with comparative studies, allows to better understand and determine the role of the state and the scientific community in the implementation of energy transfer at a specific historical stage. In the foreign policy of the USSR, there is a certain detente towards the so-called competitive coexistence. The task of the USSR in this sense was to peacefully economically compete with opposing socio-political systems while maintaining ideological opposition. Politics has developed a two-level approach to stability. On the one hand, there was a desire to give stability to relations with the West.

On the other hand, it was possible to indirectly oppose it in certain specific issues. Based on these methods, it is possible to explain the facts under consideration.

6. Findings

6.1. Aswan dam: problems of international agreements on technological transfer

Based on archival materials, the authors analyzed the technological transfer in the energy sector, in particular, studied the stages of agreements, project developments, and implementation of the construction of the Aswan dam. This project was the largest international energy innovation.

The government of the United Arab Republic involved design and research organizations from Germany, England, Sweden, France, and the USSR in the development of the high-rise Aswan dam. A board of consultants was created from the most prominent scientists of the USA, France and Germany. The escalating political crisis (the Suez crisis) made adjustments to the construction plan, but the progress of its implementation was impossible without an international transfer. The construction of the dam was carried out in unusual and difficult conditions. In the process of creative collaboration in the analysis of the project, a group of Arab specialists, headed by Minister Musa Arafa and Professor Hassan Zaki, and foreign experts, including Soviet scientists, put forward technical proposals. A long discussion by the High Committee for the construction of the Aswan dam was in favor of the Soviet version. The experience of applying a new technological method approved by the Egyptian side was carried out in the USSR by a Hydro project during the construction of the Kuibyshev Hydroelectric Station. It should be noted that in the system of the Ministry of construction of power plants in the USSR there were powerful construction organizations, among them, Kuibyshevgidrostroy, Stalingradgidrostroy, who had experience in the construction of major hydraulic structures in similar conditions. Despite the choice of the USSR as the general contractor, the international scientific Advisory Council consisting of Western and American professors (Russian State Archive in Samara (RSA in Samara)) remained in force. F. R - 109. Op. 6-6. D. 30. L. 1-17).

The Soviet side implemented the project through a vertical departmental management structure that existed in the country. The Commission of the Presidium of the Council of Ministers of the USSR on external economic issues of the Ministry of construction of power plants carried out coordination with the first deputy chairman of the Council of Ministers of the USSR A. I. Mikoyan. In the draft resolution of the Council of Ministers of the USSR prepared and submitted on January 27, 1958, the organization was nominated as the main developer. The organization is called "Gidroproekt" The involvement of firms from capitalist countries as contractors, as indicated in the agreement, was excluded. However, the documents show the opposite. Representatives of the all-union export-import association Technopromexport in a letter to the chairman of the State Committee for Science and Technology of the USSR on foreign economic relations Skachkov informed about the difficulties encountered in agreeing on project financing. Representatives of the Egyptian side categorically refused to consider the total cost of equipment and materials and demanded to provide them with position prices. The total cost of materials left in the contract for deliveries from the Soviet Union was only 4 million 734 thousand rubles. The cost of project work after a long discussion was agreed in the amount of 700 thousand rubles. During the negotiations, it turned out that the representatives of the UAR, in particular, Professor Zaki, were well familiar with the existing methods of evaluating project works in the world and had American and English methods, but did not agree

with any of the methods of evaluation. It should be noted that in a conversation with the soviet delegation, Zaki repeatedly stated that if we insist on our own method of evaluation, he will transfer the execution of design work to English and French firms.

Technology transfer between the USSR. and the UAR was carried out on the basis of concluded agreements that presuppose long-term relationships stipulated by legal agreements and aimed not only at transmitting information, but also at transforming it into innovation. The documents show the difficulties encountered during construction. Minister of construction of power plants Novikov received information about disruptions in the supply of equipment. Departmental disunity hindered the implementation of the project. The state committee for external economic relations applied to the Council of Ministers of the USSR, the State Planning Committee of the USSR for additional allocation of resources for the Aswan dam (Russian State Archive in Samara (RSA in Samara). F. R - 109. Op. 1-6. D. 396. L. 52-102). At the same time, the Ministry of power plant construction did not regulate the planning of equipment deliveries. For its part, the government of the UAR has established a special organization for administrative and technical management and financing of construction. Thus, based on the documents, it was revealed that at the transfer stages, the most difficult issues were the coordination of the technical project and financing. In the national development program of the UAR, this project, proposed by Nasser, occupied a dominant position and became a matter of national pride.

6.2. Research institute and the directions of international cooperation

International cooperation in the field of technology transfer of the union head research institutes testifies to the variety of forms of scientific and technical cooperation with the West in the 1950s and 1960s. This ensured the Soviet Union's integration with the world scientific community. Continuity in the implementation of the GOELRO plan at this stage was traced in the expansion of foreign contacts of the research Institute on the development of the energy industry.

Specialized conferences were the channels of international interaction. Technical development of the section "electrification of the USSR" for exhibitions in London and Paris in 1961 was carried out by the research Institute "Gidroproekt" The All-union Chamber of Commerce allocated an area of about 900 sq.m. for the exhibition of the electrification of the USSR, among the exhibits were solar panels. This institute provided design and survey works in Syria to develop a scheme for using the Euphrates river and carried out expertise for the construction of a hydroelectric power station (Russian State Archive in Samara (RSA in Samara). F. R - 219. Op. 3-1. D. 213. L. 1-7).

The development of the industry questions are reflected in the extensive correspondence of scientists with foreign colleagues. Researcher of the Siberian research Institute of energy V. K. Shcherbakov, in correspondence with the French scientist Gerard Lehmann, writes on issues related to the operation of main electrical transmissions. It was an exchange of theoretical studies, but already largely experimentally proven. Scientists with a high degree of confidence spoke about the efficiency of these electrical transmissions at distances of 1500-4000 km. Similar problems arose in different countries of the world. Laboratory studies of Novosibirsk scientists were well known in the world scientific community (Russian State Archive in Samara (RSA in Samara). F. R - 287. Op. 1-6. D. 220. L. 21-24).

Scientific problems of electrification of the USSR were solved by the G. M. Krzhizhanovsky Power Engineering Institute. Analysis of the Institute's documents allowed us to draw some conclusions about the level of energy development and the industry structure of energy consumption in the USSR and the USA. A comparative study on the state and technical trends of energy development in the study period allows to speak about five leading countries: England, the USA, the USSR, Germany, and France. Within the existing technological processes, the most important trend was to gradually reduce the specific energy consumption compared to the pre-war period. These trends were particularly noticeable in the United States. The coefficient of electrification of the fuel and energy balance in the United States in 1954 was 30.2%, in the USSR - 29.9 %. In the 1950s, the growth rate of the USSR's electric power supply in certain industries exceeded the growth rate of the United States. In particular, the oil refining industry of the USSR. For 1953-1958 growth was 100%, in the United States - 40%. The absolute gains in these industries were also close to those in the United States, but the overall gains across the industry were lower than in the United States. Therefore, the ratio of electric power has changed not in favor of the USSR. In 1950 the USA surpassed the USSR by 2.7 times, and in 1957 by almost 3 times (Russian State Archive in Samara (RSA in Samara). F. R - 249. Op. 3-1. D. 28. L. 3-65).

The documents of the State Union Design Institute "Promenergobank" contain information about the possible extension of the use of nuclear power plant energy. Among the countries that developed this problem, its practical application was received in the late 1960s in Sweden, Switzerland, Norway, Germany, and the United States. In 1965, the total capacity of nuclear power plants in the world was 6 GW (Russian State Archive in Samara (RSA in Samara). F. R - 219. Op. 3-1. D. 213. L. 1-7).

7. Conclusion

The experience of international technological interaction considered by the authors is of a multilateral interstate nature. Firstly, both the Soviet side and Western engineers and scientists were involved in the development of the Aswan dam. The political crisis that strained Egypt's relations with the West led to the possibility of discussing the Soviet project. Secondly, investments from the world bank, the USA, and the United Kingdom were considered for financing the project at the initial stage. However, the high cost of the project and the investment conditions provided for Western intervention in Egypt's economic policy. Lending of the project was transferred to the Soviet side according to the accepted agreements. Thus, the organizational, institutional, and economic components of the design and construction of the Aswan dam were formed from the conditions of political confrontation. The transfer could not be provided solely based on the technical parameters of the submitted projects. The approved Soviet version of the design, as shown by the analysis of documents, was not without drawbacks, despite the existing experience in the construction of similar structures in the USSR. International transfer, as a system of agreements between agents, involves not only the transfer of technology, but also its adaptation to new conditions.

Channels and mechanisms of interaction with foreign subjects on the part of the USSR were built on the basis of government decisions. The main role in the system of international contacts was assigned to research institutes. The nature of their activities allows to draw conclusions about current scientific

developments in the field of energy. Promising projects were discussed at international conferences and congresses, as well as in personal correspondence of scientists.

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