Article

Iraq Oil Industry Infrastructure Development in the Conditions of the Global Economy Turbulence

Tahseen AL-Saadi, Alexey Cherepovitsyn and Tatyana Semenova

Economics, Organization and Management Department, Saint Petersburg Mining University, 2, 21st Line, 199106 Saint Petersburg, Russia
* Correspondence: tknow@mail.ru

Abstract: The resource orientation of the Iraqi economy implies the development of a competitive advantage of the oil industry through the industry’s infrastructure development. The authors’ assumption is that as a result of the transport and production infrastructures’ development of the extraction, processing and transportation of oil and oil products in the conditions of global economic turbulence and the availability of profitable mineral raw materials, domestic demand is restrained by both “inherited” problems and new challenges for the Iraqi oil industry. A review of changes in oil production over time has been carried out. The following problems have been identified: “inherited” problems of the oil industry’s production infrastructure, insufficient capacities and technologies and unbalanced attraction and use of investments. It has been identified that problems vary with different infrastructures. For transport infrastructure, transportation security threats, the insufficient capacity of ports and routes, low level of management and technical implementation are the main problems. New challenges in the oil industry’s infrastructural development are related to the fall in oil prices, the reorientation of supply chains, the “blockage” in world trade due to coronavirus infection and the challenge to expand the use of renewable energy resources to improve the quality of energy supply in terms of resource distribution. The aim of this study is to develop theoretical and methodological bases for the development of infrastructure in the Iraqi oil industry with reference to its background, associated with the turbulent path of the global economy. The substantiation of theoretical provisions and development of practical recommendations to facilitate development of the Iraq oil industry infrastructure are aimed at supporting the development of its infrastructure in view of economic and political instability. Thus, the theoretical and practical significance of the study lies in revealing the features and problems of the Iraq oil industry infrastructure functioning and the development of an algorithm of control for the development of its elements.

Keywords: oil; global economy; Iraqi infrastructure; efficiency; program management

1. Introduction

In the process of Iraq’s economy developing, the oil industry’s infrastructure is developing, which is constrained by a number of problems and risks. In the authors’ opinion, the problems are classified as “inherited” and associated with “path dependence” and reflect considerations such as the dependence on global oil prices; problems of transregional relations; lack of unified rules for the sustainable development of the oil and gas industry [1–4]; and the problem of providing electricity to industry and the population in Iraq [5–7].

Increases in the competitiveness of companies are due to their technological development with the use of foreign capital [8]. The use of innovative components by oil-producing and oil-refining Iraqi companies, taking into account risk management, facilitates a decrease in losses in the logistics, extraction and processing of raw materials, which makes it possible to reduce costs [9]. Maintaining infrastructure at the proper level requires the active involvement of the state, assuming a mechanism for redistributing contractual income,
including proceeds from oil and gas rent, stimulating and developing tax legislation and industrial policy for the growth of innovation and industry specialization regions [10,11].

The structural industry of Iraq is oil and oil refining, which ranks fifth in the world in terms of proven reserves of crude oil and seventh in terms of intensity of oil production compared to the United States, Russia and China. Proven reserves allow for increasing production volumes. The state of production and transport infrastructures, among other things, is the cause of the falling-off in demand for oil. Coronavirus infection has become an evident problem causing a price imbalance since 2020, while the cost of Iraqi oil export has decreased by 47% (from USD 80.027 billion in 2019 to USD 44.287 billion in 2020) [12].

The substantiation of theoretical provisions and the development of practical recommendations to facilitate the development of the Iraqi oil industry’s infrastructure will support the development of its infrastructure in view of economic and political instability. Based on the works of E.O. Kasaeva, N.M. Fomenko, M.D.Kh. Al Mashkhadani, R.R. Subkhankulova, I.M. Mohammed, E.V. Pashkova, Al-Khalidi, Haider Ibrahim Hassoun and others and reviews provided in Reuters, Economist Intelligence, Bloomberg, Iraq Oil Production News, OPEC data and national statistics of the Republic of Iraq, we have identified the following aspects [13–15]:

1. Oil industry infrastructure is a group of branches and activities that determine the production of oil and oil products and their processing and logistics to consumers. It is necessary to separate the functioning for the oil and gas industry of Iraq into macro-, meso- and microlevels, which made it possible to come to the following conclusions:
   - At the microlevel (individual oil companies), the infrastructure is determined by a set of facilities;
   - At the mesolevel (individual territories, districts), by groups of branches and institutions for regulation;
   - At the macrolevel (individual states), by general conditions of economic activity. The market infrastructure seems to be more complex in terms of its structure, which can be the subject of individual studies.

2. To develop a specific concept for the oil industry’s infrastructure development, it is important to comprehensively develop all three levels and approaches to understanding the essence of infrastructure [9,16–18], which is reflected in Table 1.

Table 1. Oil industry infrastructure by levels.

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Level</th>
<th>Interpretation of Infrastructure</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Microlevel (individual oil companies)</td>
<td>Complex of facilities</td>
<td>LUKOIL infrastructure: booster pump stations, cluster pump stations, refineries, oil pipelines, etc.</td>
</tr>
<tr>
<td>2</td>
<td>Mesolevel (individual territories, districts)</td>
<td>Complex of industries and institutions performing regulation functions</td>
<td>Port of Mina Al Bakr: 2 berths and 4 tankers for transportation of oil to foreign countries</td>
</tr>
<tr>
<td>3</td>
<td>Macrolevel (states)</td>
<td>General conditions of economic activity</td>
<td>Oil pipeline system in Iraq: Kirkuk–Ceyhan pipeline, Kirkuk–Tripoli pipeline</td>
</tr>
</tbody>
</table>

Source: prepared by author on the basis of [9].

To identify a relationship between the oil industry and its infrastructure in the “system-service subsystem”, note that the oil industry technologically includes the following cycle of work with resources [19–21]: extraction, storage, transportation and processing.

3. Infrastructural facilities of the oil industry are production facilities (production infrastructure) and domestic as well as socio-cultural and residential facilities (social infrastructure). Production infrastructure performs the function of direct support of the material production process. Social infrastructure includes industries that are indirectly related to the production process (medical facilities, educational institutions, cultural institutions, residential buildings, etc.) [22].
In order to improve the efficiency of the development of the Iraqi oil industry, it is necessary to use the most modern approaches to the management of the development of the industry. To ensure effective solutions to the problems in this area under the conditions of economic turbulence, it is necessary to form a scientific-theoretical basis. Thus, this study aims to analyze the state of the infrastructure of the oil industry in Iraq and to form a conceptual and methodological approach to increase the efficiency of its development in modern conditions, marked by the turbulence of the global economy. The novelty of the study is to develop a conceptual and methodological approach to ensure the development of infrastructure of the oil industry based on the use of the model of the system of indicators of strategic development, program approaches and integrated assessment of efficiency.

To substantiate the theoretical concept and develop practical recommendations, the developments in the field of balanced scorecards were used [23–25]. The analysis showed that this concept, which allows improving the efficiency of strategic management, is practically not used to manage the development of infrastructure of the oil industry [24–27]. In addition, there is a problem of the sectoral adaptation of this approach, which has not been solved at present.

The most crucial component of the developed model of management on the basis of the balanced scorecard, as well as an implementational tool, are the programs being developed. The authors have analyzed the scientific developments in the field of program-targeted management [28–30].

The analysis revealed that in the management of development on the basis of a balanced scorecard, little attention is paid to the development of programs. It is the use of the Management by Objectives approach and a comprehensive assessment of program effectiveness that, in the authors’ opinion, should contribute to the dynamic development of the Iraqi oil industry’s infrastructure.

Target-oriented programs provide a means of increasing the scientific validity of managerial decisions due to the fact that they strengthen their targeting, elaborate the ways and options of achieving long-term goals, allow linking the goals with resource opportunities and give a more detailed view of what the stages are for consistent solutions to the problems [30–32]. All this is necessary when managing the development of the oil industry’s infrastructure. The programs allow speeding up the processes, leading to the solution of the problems of economic and social development, reducing the terms of achieving the goals and target benchmarks, which are of paramount public priority. For Iraq, the effective development of the oil industry’s infrastructure is not an end in itself, but a vehicle for the sustainable socio-economic development of the whole country.

Management by Objectives should be used in the context of the existence of critical situations, which do not find their solutions in the inertial mode of functioning and development of the programmed system. The management of the oil industry’s infrastructure development is associated with the settlement of problems which hold a special place. These problems should be called program-related, since they require a Management by Objectives approach in order to be solved.

The prerequisites for the program development of problems imply the following requirements: the relevance of a problem’s solution for the industry, region or country as a whole; strict targeting of the problem and certainty of the final result of its solution; a particular complexity of the problem structure, which requires solving a large number of special tasks and makes it necessary to involve enterprises of related industries in its solution; the need for centralized (target-oriented) resource provision of problem solution; and the novelty of the used technical, organizational and other solutions. These features are the problems of the oil industry’s infrastructure development.

Despite the existing developments in the field of balanced scorecards and Management by Objectives, there are many outstanding methodological, specific, procedural and organizational issues. There is no agreed initial prerequisite associated with the formation and utilization of the range of development goals in management, there is no unambiguous understanding of the place and role of programs in the system of strategic management.
and there is no common understanding of common criteria for assessing the public benefit of the final results \([33–35]\).

In addition, there is no comprehensive approach to assessing the effectiveness of programs and projects in this area, which would take into account the integrated economic, social, environmental and technological efficiency \([36,37]\).

A review of the scientific papers indicates that virtually any investment project implemented in any country, even given its positive characteristics and importance for society, must contain an economic or social effect (or both together) and thus ensure the reimbursement of the invested funds. In the case of infrastructure projects, along with purely economic goals, the creation of additional jobs, environmentally friendly industries, achieving additional social effect, as well as compliance with modern scientific and technological-level requirements should be of interest.

2. Methodology

2.1. Methods of Research on the Development of the Infrastructure of the Oil Industry in Iraq

The study relies on the statistical data of the Iraq Oil Ministry, reviews by Reuters and Economist Intelligence and OPEC data. The methodology and methods of the study are based on the main provisions of industrial economics, the sustainable development concept and theories of the international division of labor, which determine the development of world oil markets \([38–41]\).

To achieve the goal of the study, general scientific methods of analysis, synthesis, aggregation and generalization were used, as well as methods for the statistical processing of quantitative data and conceptual interpretation of conclusions in view of economic, political and historical aspects of the oil industry functioning in Iraq.

Assessment of the state of the infrastructure and identification of problems in the development of the infrastructure of the oil industry involves taking into account the following circumstances:

1. The differentiated composition of the oil industry infrastructure leads to the need for information richness in various other branches and sectors of the economy, while we focus on the production and transport components as priority infrastructure for the oil industry in Iraq.

2. Data collection is difficult because the infrastructure is not a cumulative single accounting unit and is not combined with management systems \([15]\). Therefore, in this case the authors proceed from the specific goals of the study when collecting and grouping data \([14,42]\).

According to OPEC \([8]\), Iraq has the world’s second largest crude oil reserves, which are characterized by shallow depth, high-quality oil and low production costs. Despite the availability of 415 explored, 17 suspended and 73 developed oil fields \([1]\) with a total volume of 147.2 billion barrels of oil reserves, opportunities for development of the oil industry are limited by a weak infrastructure, which, in view of unstable foreign policy and dependence on conditions of the global energy markets, is manifested in severe depreciation of fixed assets, lack of pipelines, power shortages inherent in production and transport and energy infrastructure components.

The study of issues of functioning and development of the oil industry leads to the conclusion that its infrastructure should include transport, social, institutional and information (increasingly digital in form) components in addition to the direct production components \([42,43]\).

Being assets, infrastructure facilities can be divided into tangible and intangible, which allows for dividing the infrastructure of the oil industry into the following components (see Table 2):

- “Rigid” (production, transport, social);
- “Soft” (institutional and information) \([14]\).
Table 2. Oil industry infrastructure composition.

<table>
<thead>
<tr>
<th>Production</th>
<th>Transportation</th>
<th>Social</th>
<th>Information</th>
<th>Institutional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumping units, control stations, metering units, transformer substations, water injection unit, etc.</td>
<td>Tanks for the storage of oil, oil pipelines, tankers, etc.</td>
<td>Residential buildings, medical facilities, educational institutions, etc.</td>
<td>Project documentation (general layouts of the project development), systems and procedures for collection, storage, analysis and transfer of information, etc.</td>
<td>Oil and Gas Law, Complex National Strategy for the Development of Energy Sector in Iraq, Oil Ministry, Iraqi National Oil Company</td>
</tr>
</tbody>
</table>

“Rigid” infrastructure is the entirety of material objects of buildings, equipment and facilities that create a material basis for the operation of the oil industry. “Soft” infrastructure is the entirety of information and institutional and management resources associated with enabling the process of the infrastructure’s services provision.

Analysis of trends for state regulation of the oil industry infrastructure development through state investment suggests that the most important of them are:
- Increasing the total financing volume;
- Regulating the ratio of public and private capital;
- Setting the ratio of new construction and restoration (modernization) of existing facilities;
- Reasonable location of new oil industry infrastructure facilities.

The leading role of state regulation in the development of infrastructure is due to institutional function of the state in any economic system, including regional or sectoral systems.

The most important factors in the development of the oil industry in Iraq should be: the availability of a significant mineral resource base, strong governmental regulation, unstable foreign policy, dependence on world market conditions, active involvement of foreign companies in the development of oil fields as well as the low living standard of people.

Amid a lack of funding and innovation experience in the creation of new jobs and the stimulation of the oil industry, it is necessary to attract foreign investment and license the participation of foreign companies in field development, as well as to prevent the illegal export of crude oil and oil products to Turkey, Jordan, Syria, Iran and Dubai, which requires an adequate institutional support of the oil industry infrastructure in the legal sense.

Inducing and maintaining the proper functioning of these infrastructure facilities requires state regulation, which may include the financing of target programs, as well as supporting entrepreneurial initiatives. It is the state that is responsible for the integration and regulatory function of the institutional infrastructure at the upper infrastructural level within boundaries of territorial and economic systems.

To indicate strategic goals and objectives, it is necessary to apply key performance indicators that quantify the level of the expected achievement of these goals. Therefore, in order to improve efficiency of state regulation of the Iraqi oil industry’s infrastructure development, it is proposed to use the oil industry’s infrastructure strategic development scorecard. This scorecard is based on the balanced scorecard concept, which is used to manage the development of enterprises and territories in various countries.

Currently, the applied indicators of infrastructure activity are used, actually, to solve tactical problems, i.e., to achieve short-term goals. The task of the strategic development scorecard (SDS) is to transform the strategy into specific, tangible tasks and indicators. This scorecard should be balanced and reflect the balance between short-term and long-term goals and external and internal factors between outcome measures of past performance and future development.
The largest conceptual works in the field of the balanced scorecard are the studies performed by R. Kaplan and D. Norton [54]. A balanced scorecard translates the mission and overall strategy into a system of clearly defined goals and objectives, as well as indicators that determine the extent to which these goals are achieved. Thus, whereas originally the scorecard was intended by the developers as a development control mechanism (strategic and tactical), now it has turned into a comprehensive control system without losing its control functions. This approach coincides with the opinion of the founders of the balanced scorecard concept (BSC). Based on this view of the scorecard, in general, the BSC can be considered as a system of the strategic management of a facility based on measuring and evaluating its effectiveness against a set of balanced indicators that ensure that aspects of its activity that are significant from the point of view of strategic development are taken into account. This tool aims to translate the overall strategic direction into a system of interrelated indicators that can be quantified.

2.2. Formation of a Balanced Scorecard

The analysis has shown that the strategic development scorecard should have the following six mandatory elements.

1. Prospects—the main projections of activity in which the strategy is decomposed in order to be implemented. In the BSC, the prospects are reflected in the form of strategic projections (maps). Usually, four basic strategic projections are used, but their number can be increased in accordance with the strategy specifics.

2. Strategic goals, which are formulated in accordance with the strategy directions and refer to one of the strategic maps of the system. By nature, they are a decomposition of the main goal of the socio-economic system in a certain key area of activity.

3. Indicators, which are measurable summaries of goals, i.e., quantifiable categories that reflect progress towards a strategic goal. Indicators imply certain actions necessary to achieve the goal and indicate how the strategy will be implemented at the operational level. The indicators are designed to bring complex and often vague goals into a more specific and understandable framework. At the same time, their system allows viewing the current situation in a strategic perspective.

4. Target values—the values of indicators that must be achieved over a certain period.

5. Cause–effect relations link strategic goals (or indicators) into an integral chain in such a way that the achievement of one of them determines progress in achieving the other.

6. Strategic initiatives—programs and projects that contribute to the achievement of strategic goals.

Within the BSC, we can distinguish indicators that measure the results achieved (lagging indicators of the past performance quality), and leading indicators that reflect the factors of activity that lead to the incurrence of lagging indicators.

What follows are the stages of developing the oil industry infrastructure strategic development scorecard.

Stage 1. At this stage, it is necessary to determine the main strategic projections. This can be carried out by infrastructure types.

Stage 2. Identifying key success factors and development of strategic goals for each projection of the oil industry infrastructure’s strategic development scorecard. The process of goals formation is cyclical, and the initial strategic goals system can change significantly as a result of work to identify cause–effect relations. At this stage, criteria for setting goals should be developed, which will further allow setting the performance indicators’ target values.

BSC developers recommend three goals per strategic map. Due to the complexity of the infrastructural development tasks, it is practical to increase this number up to 4–5, as appropriate. When developing a system, the determining factor is the need, on the one hand, to take into account all the most important goals and, on the other hand, to prevent the blurring of priorities.
Stage 3. Determining links between strategic goals. At this stage, it is necessary to show that the efforts made to achieve each intermediate element will ultimately contribute to the achievement of the highest priority infrastructure development goals.

The determination of cause–effect relations in the strategic development scorecard is associated with the decomposition of the goal tree included in the scorecard according to strategic maps.

Links can exist both between goals within a single infrastructure component, and between goals of different maps. At the same time, the size of the scorecard should be minimized by excluding goals related to one element of the projection and having a close direct interdependence, since the achievement of one of them will mean the meeting of the other. Therefore, duplicate goals should be excluded at the stage of identifying links.

Stage 4. Alignment of short- and long-term goals. The goals have a time horizon, and the duration of the achievement period, as a rule, is proportional to the significance of the goal, since the final goal is achieved through intermediate ones. The main task of this stage is to check the subordination of less important and short-term goals to more significant and long-term ones.

Stage 5. Development of indicators and target values. Each goal is associated with one or more indicators, the achievement of which should reflect progress towards the goal. The indicator acts as a quantitative summary of the goal.

After approval of the indicators list, it is necessary to determine their target values. Simultaneously the following must be kept in mind: the world and national level, the level of the best regions, historical records, the legislative standard, the new technology standard and state support possibilities.

Stage 6. Development of the strategic initiatives (programs) plan. In order to make the oil industry infrastructure’s strategic development scorecard an effective tool for strategic management, appropriate programs must be developed.

Both existing and new initiatives can be used for the purposes of the strategic development scorecard. An inventory of the programs being implemented and the programs planned during the development of the strategy should be made. Each strategic initiative can influence the outcome of one or more indicators. It should also be kept in mind that not all programs being implemented should be included in the strategic development scorecard.

Stage 7. At this stage, a final table should be compiled reflecting the developed scorecard.

The management based on the system of strategic development indicator model requires information communication on the one-loop principle, i.e., information about the processes of program implementation and the achievement of target indicators should be received by the management bodies. If the operating environment changes, the model may need to be adjusted. State authorities need to receive information on the basis of a “double loop” of feedback in order to analyze whether the developed strategic direction remains correct in the changing conditions.

2.3. Methods of Forming a Comprehensive System of Indicators for the Development of the Infrastructure of the Oil Industry

The development of a comprehensive system of program indicators involves the use of an expert method. The determination of the specific weights was carried out on the basis of an expert survey of specialists in the oil and gas sector with the substantiation of the reliability of the expert survey by calculating the concordance coefficient.

The summary score for each criterion is determined by the formula:

$$y_i = \sum_{j=1}^{m} w_j \times c_j$$

where $y_i$—summary score for $i$, the mu criterion (in points);

$w_j$—the weight of the $j$-th indicator (the total weight of the indicators characterizing this criterion is 1);

$c_j$—expert opinion on $j$-th indicator;
In the expert survey, experts in the oil industry with a scientific degree took part. Consistency of the experts’ opinions was assessed with the help of the concordance coefficient. The concordance coefficient is calculated according to the following Formula:

\[
W = \frac{12 \cdot S}{m^2 n \cdot (n^2 - 1) - m \cdot \sum_{j=1}^{m} T_j}
\]  

(2)

The value of \(S\) is calculated as follows:

1. For each factorial feature, the sum of ranks assigned by all the experts is determined:

\[
\sum_{j=1}^{m} X_{ij}
\]  

(3)

2. The total sum of ranks is calculated:

\[
\sum_{i=1}^{n} \sum_{j=1}^{m} X_{ji}
\]  

(4)

3. The average sum of ranks of factors is determined:

\[
M = \frac{1}{n} \sum_{i=1}^{n} \sum_{j=1}^{m} X_{ji}
\]  

(5)

4. The sum of squares of deviations of the sums of ranks of factor attributes from the average sum is determined:

\[
S = \sum_{i=1}^{n} (\sum_{j=1}^{m} X_{ji} - M)^2
\]  

(6)

The concordance coefficient is determined based on the equal scores given by the experts (“connected ranks”), which characterizes the number \(T\). The value of the concordance coefficient may vary from 0, corresponding to complete disagreement of the experts’ opinions, to 1, indicating complete agreement of the opinions. In the study presented, the value of the concordance coefficient was not less than 0.75.

The significance of the concordance coefficient was assessed using the criterion \(X^2\) actual:

\[
X^2\text{actual} = mW(n - 1) = \frac{12 \cdot S}{mn \cdot (n + 1) - \left(\sum_{j=1}^{m} T_j\right)/n}
\]  

(7)

\(X^2\) tabular is found according to the distribution table. If \(X^2\) actual is more than \(X^2\) tabular, then the experts’ opinions are considered to be consistent. Otherwise, the following measures should be taken: engage experts with higher qualification; use additional factorial features; increase the number of experts. In this study, \(X^2\) actual is greater than the tabulated value at a confidence probability of 0.01, so the experts’ opinions are considered to be consistent.

3. Results
3.1. The Impact of the “Path-Dependence” Concept on the Iraqi Oil Industry’s Infrastructure

Production and transportation infrastructures serve the production processes in Iraq. These infrastructures are the main ones for the oil production and oil refining industries of the country. The oil industry infrastructure is mainly upgraded through foreign capital, but the industry is economically dependent on export earnings.

As Table 3 shows, the largest Iraqi refineries are located in the cities of Basra and Dawra and produce 3.5 million tons and 5 million tons of oil and petroleum products annually, which account for 34% and 17% of the total oil refining, respectively.
Table 3. Dynamics of capacity of oil refineries in Iraq, thousand barrels/day, 2016–2020 years.

<table>
<thead>
<tr>
<th>No. p/p</th>
<th>Capacity, Thousand Barrels/Day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2016</td>
</tr>
<tr>
<td>1</td>
<td>Baiji</td>
</tr>
<tr>
<td>2</td>
<td>Basra</td>
</tr>
<tr>
<td>3</td>
<td>Daura</td>
</tr>
<tr>
<td>4</td>
<td>Kirkuk</td>
</tr>
<tr>
<td>5</td>
<td>Saynia</td>
</tr>
<tr>
<td>6</td>
<td>Najaf</td>
</tr>
<tr>
<td>7</td>
<td>Samava</td>
</tr>
<tr>
<td>8</td>
<td>Nasiriya</td>
</tr>
<tr>
<td>9</td>
<td>Missan</td>
</tr>
<tr>
<td>10</td>
<td>Divaniya</td>
</tr>
<tr>
<td>11</td>
<td>Hadita</td>
</tr>
<tr>
<td>12</td>
<td>Cayara</td>
</tr>
<tr>
<td>13</td>
<td>Cask</td>
</tr>
<tr>
<td>14</td>
<td>Kar</td>
</tr>
<tr>
<td>15</td>
<td>Bazyan</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
</tbody>
</table>

The technical backwardness of the technologies used, which must be replaced in accordance with environmental legislation, leads to low product quality.

Notwithstanding the nationalization of extracting companies, Iraq must attract funds from foreign investors in order to participate in tenders for field maintenance. According to the Ministry of Oil of the Republic of Iraq (http://oil.gov.iq), 25 foreign companies, including three Russian companies (Lukoil, Gazprom and Rosneft), have gained access to the resources. The study of the state and main trends in the oil industry transport infrastructure development allowed identifying the following “inherited” problems:

- Threats of terrorism, security, oil theft;
- Insufficient capacity and energy efficiency of ports and railways;
- Instability of logistics, disruption of supply chains.

Let us consider the following “inherited” problems of infrastructure development:

- Insufficient extracting and refining capacities;
- Obsolescence of technologies, insufficiency of production capacities;
- Attraction of foreign investments.

It requires that international experience in the application of modern technologies was made use of, which reduces the burden on nature in related industries [55].

The importance of the Iraqi oil industry’s transport infrastructure development is associated with the geopolitical location of Iraq and its system of pipelines, ports and tankers, railways and roads and overpasses. Through the oil pipeline, most oil passes from Turkey to the Mediterranean Sea through the port in the city of Basra. Let us consider the main pipelines: Iraq–Ceyhan (Turkey) from 1.5 million barrels per day; DNO-RPK Taukfield-Fishkhabur to Turkey, Taukfield-Fishkhabur to Turkey from the Tauke field; Kirkuk–Banias/Tripoli from the northern fields to Syria and Lebanon; Kirkuk–the Persian Gulf to the port of Basra; Iraq–Saudi Arabia. The main issues of pipeline performance are safety, logistics and investment arrangement.

The study of the state of and main trends in the oil industry’s transport infrastructure development made it possible to identify the following “inherited” problems:

- Security threats related to terrorism and theft of oil during transportation through pipelines, causing damage to transport infrastructure facilities and preventing their normal functioning;
- Insufficient throughput capability of ports and railways as a result of destruction during wars and sanctions and the need for significant investment in rehabilitation and reconstruction;
- Instability of transportation due to its insecurity and low level of centralized management, as well as maintenance.

Despite a sufficient mineral resource base of hydrocarbons, the unstable external political situation in the Republic of Iraq has led to significant damage to infrastructure of the oil industry. The Iran–Iraq war of 1980–1988 resulted in USD 100 billion in damages to Iraq’s industrial and transportation infrastructure, while missile and bomb attacks during Iraq’s war against Kuwait in 1990–1991 resulted in another USD 6 billion in damage to Iraq’s infrastructure. The U.S. and anti-Iraqi coalition military action in 2003, as well as the sabotage, brigandage and terrorism that followed, again led to severe damages to infrastructure. As a result of the 2013–2017 war, the total damage to Iraq’s economy was about USD 88 billion. Here, social infrastructure facilities were also damaged.

All this demonstrates the need for making and further improving state policy aimed at strengthening the national position in the oil industry for the purpose of improving the level and quality of living for Iraqi people. The place of state regulation in the oil industry’s infrastructure development is determined by the institutional function of the state, which is to create the “rules of the game” for actors of the production, transportation and primary oil refining processes. These rules form an institutional component of the infrastructure fitting into the overall context of the institutional environment of Iraqi society.

The observed vector of institutional transformation is aimed at:
- Openness and use of technologies and experience of foreign companies through investments;
- Consideration of interests of the Iraqi people in terms of domestic energy supply and improved welfare through the redistribution of income from oil exports.

Hence, the result of state regulation of the oil industry is an institutional component of its infrastructure.

The main areas of state regulation that contribute to the development of the Iraqi oil industry’s infrastructure include:
- Completion and improvement of legislative and strategic documents;
- Establishment and maintenance of relevant institutions and organizations;
- Development and maintenance of organizational and economic mechanisms to attract investments and redistribution of oil revenues.

However, it is necessary to consider the following:
- Need for substantial investments into technologically obsolete and inadequate infrastructure;
- Different interests in different territories;
- The high corruption level;
- Opportunities for foreign companies to develop oil fields while ensuring national energy security and improving the living standards of Iraqi citizens.

Foreign companies will play an important role in these processes in the coming decades, with the effectiveness increased by improving public policy in aligning economic interests of the Baghdad and Kurdistan governments, simplifying bureaucratic procedures while combating corruption and improving the skills of Iraqi specialists in the management of major infrastructure projects.

Conditions created by the government authorities for investments, direct participation in them and state regulation of economic relations in the oil industry, from field maintenance on down to the redistribution of oil revenues, form the basis for recovery and the creation of new facilities for transport, energy and social infrastructure, thus removing restrictions for the development of the oil industry and the entire economy of Iraq.

An analysis of the Iraqi oil and gas industry’s production infrastructure has shown its inconsistency with actual existing opportunities offered by the country’s natural resource potential as well as the domestic needs of the Iraqi economy.
The most critical issues of the Iraqi oil industry related to state of its production infrastructure are as follows:

1. Iraq’s dependence on oil and gas revenues mainly to replenish the general budget in view of underdeveloped oil and gas production infrastructure, which makes the Iraqi economy vulnerable to crisis in the event of low prices.
2. The Iraqi oil industry’s production infrastructure (both upstream and downstream) has been repeatedly damaged by wars and international sanctions that have affected both refineries and wells.
3. Technological obsolescence of refineries in Iraq and their insufficient production capacity have led to an inability to meet domestic demand for petroleum products and the need for imports.
4. Failure to properly dispose of oil wastes results in environmental pollution.
5. The need to restore or reconstruct existing facilities of the production infrastructure and create new ones in the oil industry requires attracting new investments, which requires further improvement in legislation in the oil and gas sector.

This study, based on conducting and processing expert survey data, showed that one of the most important areas for development of the production infrastructure in the Iraqi oil industry should be the technical reconstruction of oil refineries to ensure the production of motor fuels in accordance with international standards. The locations of the main oil refineries in Iraq are shown in Figure 1.

Figure 1. Location of oil refineries in Iraq.

Increasing the number of production infrastructure facilities in the oil and gas refining sector and increasing their productivity will help:

- Solve the problem of self-sufficiency of the Iraqi economy in petroleum products;
- Improve the structure of exports due to partial replacement of crude oil with petroleum products;
- Develop petrochemical and gas chemical processing facilities in the oil and gas production areas.
The characteristic feature of state regulation in terms of infrastructure is the combining of functions of customers, investors and consumers by public authorities. Market conditions of development and implementation of programs correspond to the mutual interest of public authorities and executors, competitive selection when awarding an order, identification of lead developers and co-executors of program tasks.

For many innovative projects, which should also include infrastructure projects, the global practice is characterized by a reassessment of their prospects at each stage. Stage-by-stage investment and consistent consideration of project opportunities are critical for a number of knowledge-intensive industries, which are described by long investment cycles of up to ten years. When implementing infrastructure programs and projects, the experience of different industries should be taken into account.

Table 4 shows actual and potential hydrocarbon production from some Iraqi fields.

<table>
<thead>
<tr>
<th>No. p/p</th>
<th>Field Name</th>
<th>Achieved Production Volume, Thousand Barrels Per Day</th>
<th>Estimated Production Volume, Thousand Barrels Per Day</th>
<th>Ratio of Estimated Volume to Achieved Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>West Qurna</td>
<td>300</td>
<td>700</td>
<td>2.3</td>
</tr>
<tr>
<td>2</td>
<td>Majnoon</td>
<td>100</td>
<td>600</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>Eastern Baghdad</td>
<td>20</td>
<td>120</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Nahr Omar</td>
<td>1</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>421</td>
<td>1920</td>
<td>4.6</td>
</tr>
</tbody>
</table>

Iraq currently exports about 80 percent of its crude oil production. Figure 2 shows changes in the oil exports volume over time and the average price.

![Figure 2. Dynamics of the average price per barrel of oil exported by Iraq, in 2020, US dollars.](image)

One procedure to reduce the dependence of the Iraqi state budget replenishment on global oil and gas market prices is the development of the oil refining sector, which currently receives about 20% of hydrocarbons after production, including for the purpose of the subsequent export of its products. In addition to improved quality of exports, oil refining:

- Helps in meeting domestic demand for petroleum products;
- Increases national income due to the development of oil and gas processing and petrochemical industries;
- Creates new jobs, raises incomes and improves the quality of living for Iraqi people;
Leads to great demand for and improvement in skills of Iraqi technical and engineering personnel, the introduction of modern technology and transfer of best production and organizational practices.

Today, the non-exportable part of the oil is processed at 16 refineries with a total capacity of 1,054,000 barrels per day. As Table 5 shows, the largest Iraqi refineries are located in the cities of Baiji, Dawra and Basra and annually produce 7.5, 5 and 3.5 million tons of oil and petroleum products, respectively. It should be noted that in order to meet the domestic demand for petroleum products, there has been an increase in imports in the area in question during the last two decades. The transportation infrastructure of the Iraqi oil industry includes a system of pipelines, ports and tankers, railroads and motorways.

**Table 5. Oil refineries in operation in Iraq, 2019.**

<table>
<thead>
<tr>
<th>Refinery Location</th>
<th>Refinery Name</th>
<th>Passport Capacity, Thousand Barrels/Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>North of Iraq</td>
<td>Badges</td>
<td>310</td>
</tr>
<tr>
<td></td>
<td>Kirkuk</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Al Jazeera</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Haditlia</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Erbil</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Slemani</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Kassak</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Najaf</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Muthanna</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Divaniya</td>
<td>10</td>
</tr>
<tr>
<td>South of Iraq</td>
<td>Basra</td>
<td>140</td>
</tr>
<tr>
<td></td>
<td>Maysan</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Descars</td>
<td>30</td>
</tr>
<tr>
<td>Kurdistan</td>
<td>Kalak</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>Bazian</td>
<td>66</td>
</tr>
<tr>
<td>Total Iraq (with Kurdistan)</td>
<td></td>
<td>1054</td>
</tr>
</tbody>
</table>
In order to compare the level of provision of social infrastructure in Iraq, it is necessary to use not only absolute indices but also relative indicators for the calculation of which the population of Iraq and other countries in relevant periods was taken into account. The main problems in the development of social infrastructure in Iraq are inadequate medical care for the potential workforce in the oil industry, as well as the lack of qualified personnel. Effective management of the oil production complex requires a developed information infrastructure, which is a compound network of information elements. Information interconnection of oil production and refining enterprises with infrastructure processes supporting them is provided by information infrastructure facilities such as communication devices, databases and information technology.

Indicators characterizing the information infrastructure of Iraq as a whole in comparison with other countries are presented in Table 7.

Table 7. Indicators characterizing the information infrastructure by country.

<table>
<thead>
<tr>
<th>No. p/p</th>
<th>Country</th>
<th>Fixed Telephone Lines per 100 People 2020</th>
<th>Fixed Broadband Internet Users Per 100 People 2016</th>
<th>Mobile Broadband Internet Users Per 100 People, 2016</th>
<th>Number of Mobile Subscribers Per 100 People, 2016</th>
<th>Secure Internet Servers Per 1 Million Population, 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Iraq</td>
<td>7.0</td>
<td>11.7</td>
<td>39.8</td>
<td>95.0</td>
<td>18.0</td>
</tr>
<tr>
<td>2</td>
<td>Iran</td>
<td>37.3</td>
<td>9.5</td>
<td>10.7</td>
<td>87.8</td>
<td>2422.0</td>
</tr>
<tr>
<td>3</td>
<td>Russia</td>
<td>20.7</td>
<td>17.5</td>
<td>65.8</td>
<td>155.1</td>
<td>13,348.0</td>
</tr>
<tr>
<td>4</td>
<td>USA</td>
<td>33.8</td>
<td>31.1</td>
<td>102.7</td>
<td>110.2</td>
<td>140,308.0</td>
</tr>
<tr>
<td>5</td>
<td>Saudi Arabia</td>
<td>16.0</td>
<td>23.4</td>
<td>99.0</td>
<td>179.6</td>
<td>229.0</td>
</tr>
<tr>
<td>6</td>
<td>Qatar</td>
<td>16.3</td>
<td>9.9</td>
<td>73.0</td>
<td>145.8</td>
<td>433.0</td>
</tr>
</tbody>
</table>

As we can see, Iraq has the highest lag in the field of information security, and the lowest one in the field of mobile communications.

Issues associated with the information infrastructure:

1. No in-house servers. Servers are provided by a foreign country.
2. The broad-band Internet is provided by foreign countries. Internet used in Iraq is provided by Airthink or from Turkey, Kuwait and the UAE. There are about 13 Internet providers in Iraq, with only two of them being Iraqi.
3. The Ministry of Communications fully controls the Internet and shuts it down for one or two days if there are events such as demonstrations in Iraq. In addition, the Internet is turned off for three hours during exam periods in schools.
4. Internet quality is mainly poor due to low speeds and intermittent power supply.
5. High price of the Internet, viz., minimum USD 25 per month
6. Insufficient area of the mobile communication network coverage. All this causes unstable and low-speed mobile Internet and poor telephone service.
7. Iraq does not produce equipment for information systems, but purchases it from foreign countries. Software is also purchased from foreign countries.

Therefore, a step-by-step algorithm should be developed to manage the Iraq oil refineries infrastructure development, which is as follows:

1. A preliminary review of the main trends in the global oil refining industry development in relation to innovation and application for the Iraq oil refineries infrastructure development;
2. General description of the oil refining industry in the Republic of Iraq;
3. Review of the problems and prospects for the development of the oil refining industry in the Republic of Iraq;
4. Rationale for the project of refinery construction, refinery infrastructure and determination of their location;
5. Determination of the goals, objectives of the project, key stakeholders of the projects and the project team formation;
6. Calculation of technical and economic indicators of the project;
7. Scheduling of the main stages of the project, completion periods matching;
8. Selection of vendors and contractors, awarding contracts;
9. Project budget establishment and sources of financing determination;
10. Calculation of integral indicators of the project economic efficiency;
11. Project risks analysis and elaboration of mitigation measures;
12. Project planning and progress monitoring.

The goal of the project is the organization of the production of motor fuel from oil, as well as products of organic synthesis.

Circumstances taken into account by project development include:
- The touchy economic situation in the Republic of Iraq;
- Dependence on external suppliers of basic oil products;
- Cash outflow for the purchase of petroleum products;
- The country’s underemployed population.

Concomitant circumstances by project development include:
- A well-developed petroleum products consumer market in the country and throughout the world;
- A well-developed transport system (roads and railways, port);
- The availability of land resources sufficient to allocate a site for refinery construction, laying an oil pipeline and a product pipeline;
- The possibility of connection to the main oil pipeline;
- The possibility of obtaining state limits for providing the refinery with raw materials, i.e., oil.

Setting the main tasks for the new refinery include:
1. Implementation of the state-of-the-art technologies and equipment that allow processing all after-products formed in the production of motor fuels into high-value-added, commercially successful products;
2. Involvement of natural gas and coal in the production cycle as a raw material other than oil in order to achieve maximum business profitability and reduce price risks in the mineral market;
3. Production of all components necessary for the production of finished products at the enterprise.

Location of the new refinery.
For the successful implementation of the project and the achievement of the calculated indicators, the refinery construction site must meet the following criteria:
1. Availability of well-developed transport infrastructure for supplying the refinery with raw materials and the shipment of finished products;
2. Proximity of large markets for commercial products;
3. Convenience of the products’ export in terms of transport infrastructure: a short transportation leg and availability of well-developed transport infrastructure that can ensure the high profitability of export deliveries;
4. Favorable environmental situation in close proximity to the proposed site: the absence of business entities, whose synergistic impact on the region’s ecosystem can lead to deterioration in the environmental situation in the nearby settlements and water bodies.
5. The proximity of high-quality, well-developed and large-scale social and educational infrastructure.

It is necessary to take into account the prospects for the development of alternative energy technologies, namely, solar [56–58] and wind [59] technologies.

3.2. Development of the Strategic Development Scorecard of the Iraq Oil Industry

The study shows that the use of the oil industry infrastructure’s strategic development scorecard, based on the BSC concept, should boost the efficiency of strategic management. The strategy implementation mechanism should be detailing, based on indicators that have a hierarchy (in order to determine the priority of spending resources), and contain a control mechanism.
Figure 3 shows the strategic projections of the proposed oil industry infrastructure strategic development scorecard model. To improve manageability by oil industry infrastructure strategic development scorecard buildup, it is advisable to aggregate subsystems: social and environmental subsystems constitute a socio-ecological subsystem.

Figure 3. Strategic projections of the system of indicators for the development of oil industry infrastructure.

For the strategic development scorecard, key indicators should be selected. It is necessary to present the scorecard as concisely as possible without losing effective data. Based on the international experience, the following recommendations can be formulated for the oil industry infrastructure’s strategic development scorecard creation:

1. Aggregation: it is advisable to use the maximum possible level of subsystems consolidation.
2. The selection of representative indicators: it is necessary to determine the variables that provide reliable informational characteristics of the subsystems state.
3. “Compression”: it is advisable to identify indicators that reflect the influence of the main factors in development and functioning of the subsystems.
4. Vulnerability hotspot approach: the most vulnerable hotspots in a given system should be identified and appropriate indicators defined.
5. The averaged value of several indicators: if it is necessary to consider a number of indicators representing in some respect diverse aspects of the question of assessing the reference point, an index that provides an averaged description of the situation can be determined.
6. Indicator with the lowest value: if the satisfaction of the reference point depends on the acceptable state of each of several indicators, the indicator with the lowest value can be taken as the representative.

The strategic development scorecard does not replace the actual parameters scorecard. The indicators for the strategic development scorecard should be chosen in such a way that they contribute to progressive qualitative changes in the socio-economic system. The oil industry infrastructure’s development scorecard should prevent the possibility of exaggerating the significance of one indicator or one component.

Table 8 presents a summary table reflecting the Iraqi oil industry infrastructure’s strategic development scorecard.
Table 8. Iraqi Oil Infrastructure’s Strategic Development Scorecard Summary Table.

<table>
<thead>
<tr>
<th>Strategic Projections (by Type of Infrastructure)</th>
<th>Objective</th>
<th>Indicators</th>
<th>Target Values</th>
<th>Programs, Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production infrastructure</td>
<td>Increase in oil production</td>
<td>Crude oil production volume, million barrels per day</td>
<td>9500</td>
<td>Exploration and development of undeveloped deposits</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Capacity of oil refineries, thousand barrels per day</td>
<td>1000</td>
<td>Establishment of an industrial park near Basra</td>
</tr>
<tr>
<td></td>
<td>Increasing the capacity of refineries</td>
<td>Number of oil refineries in Iraq</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Transport infrastructure</td>
<td>Increase in the number of equipped ports</td>
<td>Number of equipped ports for tankers, units</td>
<td>7</td>
<td>Construction of an oil refinery in Basra</td>
</tr>
<tr>
<td></td>
<td>Construction of new pipelines</td>
<td>Length of pipelines, km</td>
<td>7000</td>
<td>Expansion of the Northern and Southern transport systems.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Throughput capacity of oil pipelines, million tons/year</td>
<td>750</td>
<td></td>
</tr>
<tr>
<td>Technological infrastructure</td>
<td>Increasing the capacity of refineries</td>
<td>hydrotreating power, %</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Implementation of advanced technologies in oil production and refining</td>
<td>Reforming capacity, %</td>
<td>90</td>
<td>Implementation of advanced technologies at the enterprises of the oil and petrochemical industry</td>
</tr>
<tr>
<td></td>
<td>Improving the Competitiveness of Iraq’s Oil Industry Infrastructure</td>
<td>Cracking power, %</td>
<td>90</td>
<td>Implementation of an integrated approach to evaluating the effectiveness of projects, including economic, technological, social, environmental types of efficiency</td>
</tr>
<tr>
<td></td>
<td>Volume of flared gas, billion cubic meters/year</td>
<td>7.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio-ecological infrastructure</td>
<td>Reduced gas flaring and carbon dioxide emissions</td>
<td>The amount of carbon dioxide generated as a result of burning natural gas, billion tons</td>
<td>14.5</td>
<td>Investing in the processing of associated petroleum gas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increasing the number of students for the oil industry, %</td>
<td>20</td>
<td>Monitoring compliance with technical specifications in the production and processing of oil</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Growth in the number of higher educational institutions providing training and advanced training for specialists for the oil industry</td>
</tr>
</tbody>
</table>
The provided summary table of indicators for the strategic development of the infrastructure of the Iraqi oil industry summarizes the main components of the model, which allow for improving the efficiency of management of the development of this sphere. The main components of the infrastructure, the development of which should be ensured, include the objectives for which their development should be aimed at, and the indicators that represent quantitative summaries of the objectives are highlighted. Target values are defined for the indicators, by which it is possible to draw a conclusion about the degree of the goals’ achievement. The indicators are “linked” to real actions and specific performers through relevant programs. Therefore, the system of indicators is an effective tool for strategic management. The selection of programs must meet modern requirements of efficiency, which is discussed in the next paragraph. According to the authors, in modern conditions it should be a comprehensive approach, which is considered in Section 3.4.

3.3. The Project Approach in the Management of Infrastructure Development Based on the Model of the System of Strategic Development Indicators

The study has revealed that programs provide an effective tool for implementing the management process based on the development of a model system of indicators of strategic infrastructure development.

The country should create a holistic mechanism for managing the process of attracting investment resources to finance the development of the oil industry infrastructure on the basis of programs and projects. Figure 4 illustrates the proposed mechanism of implementation of the management process of the oil industry’s infrastructure development on the basis of the model of the system of strategic development indicators, which provides a comprehensive expertise to ensure a reasonable selection of programs and projects for the funding.

The study demonstrated that the formation of the investment portfolio should be based on the development strategy of the oil industry as part of a unified strategy of economic development of the country. The Ministry of Oil of Iraq should be the supreme body on the issues of investment interaction in the industry. It will establish the requirements to the content of the projects and programs, decide on their funding and provide conditions for project implementation management and involvement of public, private and public–private companies.

According to the authors, the most important stage in the process of drawing up the programs of the oil industry’s infrastructure development is comprehensive expertise. This expertise can be treated as the tool of state regulation, engaged in order to reduce the risk and prevent possible damage to the territories when making decisions and implementing major investment projects. Comprehensive expertise of programs and projects allows for establishing an objective dependence, on the one hand, between goals and targets and, on the other hand, between resources and ultimate results. Comprehensive expertise of projects and programs of oil industry infrastructure development should envisage a comprehensive assessment of their efficiency.

A major drawback of the traditional organization of expertise is the isolation of the various types of dedicated expertise, which address the object under the constraints imposed by industry specifics. In addition, when evaluating projects, only the economic approach often prevails, from the perspective of which issues of project efficiency are discussed. This leads to inadequate allowance for the importance of other types of efficiency and to a reduced significance of environmental, social and technological factors. The expertise of programs and projects of oil industry infrastructure development should be based on system and comprehensive approaches, implemented by means of comprehensive expertise.
Figure 4. Diagram of the implementation of the management process of the Iraqi oil industry infrastructure development on the basis of the program implementation of the model system of strategic development indicators.
3.4. Comprehensive Assessment of the Effectiveness of Projects for the Development of the Infrastructure of the Oil Industry in Iraq

In management processes, efficiency usually refers to the effectiveness of actions. Efficiency is associated with a certain form of comparison of the results and the costs required to achieve these results. Determination of efficiency supposes the following procedures: measurement of the results of the system; evaluation of the results; measurement of the costs necessary to obtain these results; evaluation of costs; comparison of results and costs, i.e., calculation of efficiency.

These days, investors often do not pay much attention to the issues of competitiveness, and social and environmental problems are not properly considered. In this regard, in particular, there is a need for additional investments in environmental protection, and as practice shows, they are often comparable to capital investments to create new production facilities. All this indicates that the evaluation of the efficiency of projects and programs should be comprehensive and take into account various aspects of their implementation.

Evaluation of the effectiveness of ongoing projects is very important [60]. To increase the efficiency of the development of the infrastructure of the oil industry, an integrated approach is needed to assess the effectiveness of the developed programs (projects). The modern approach should take into account not only economic but also other types of efficiency such as technological, environmental, and social ones. The authors have developed such an approach, which is reflected in Table 9, which presents the quantitative values of the criteria and indicators of programs (projects) for the development of the infrastructure of the oil industry.

The integrated assessment for the oil industry infrastructure development program is calculated using the following formula:

\[ Y = \sum_{i=1}^{n} q_i \times y_i \]  

where

- \( Y \) — integral assessment (in points);
- \( q_i \) — the weight \( i \)-th criterion (the total weight of all performance evaluation criteria is 1);
- \( y_i \) — summary score for \( i \)-th criterion;
- \( n \) — is the number of performance evaluation criteria.

The study has shown that the evaluation of competitiveness, novelty and patentability should be part of the evaluation of technological efficiency. It should determine the nature of the technologies employed in the program (project) in terms of their place in the change in technological modes and, on this basis, the prospective competitiveness of infrastructure elements. Inadequate assessment of technological efficiency in this sense will lead to a situation where investments can be directed to the reproduction of obsolete infrastructure facilities.

Evaluation of the novelty requires the attribution of infrastructure components of the oil industry to the technological modes. At present, the world economy is dominated by the fifth technological mode, and the sixth mode is being formed. In accordance with this, programs should be approved with the fifth or sixth technological mode of the infrastructure of the oil industry. Such evaluation is made on an expert basis.
Table 9. Quantitative values of criteria and indicators of the effectiveness of programs for the development of infrastructure for the oil industry.

<table>
<thead>
<tr>
<th>Types of Efficiency</th>
<th>Criteria for Evaluating Effectiveness in Points</th>
<th>Criteria Weight</th>
<th>The Name of Indicators</th>
<th>Weight of Indicators</th>
<th>Points</th>
<th>Characteristics of Indicators</th>
<th>Recommended values of Indicators in Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td><strong>Technological</strong></td>
<td><strong>y_1 ≥ 8.2</strong></td>
<td>0.25</td>
<td><strong>Competitiveness</strong></td>
<td><strong>(y_1.1)</strong></td>
<td>0.40</td>
<td>10</td>
<td><strong>y_{1.1} = 10</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Competitiveness indicator ((\eta &gt; 1))</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(\eta = 1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(\eta &lt; 1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Novelty</strong></td>
<td><strong>(y_1.2)</strong></td>
<td>0.35</td>
<td>10</td>
<td><strong>y_{1.2} ≥ 7</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fundamentally new technologies related to the sixth or fifth technological paradigm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Improved technologies related to the sixth or fifth technological mode</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Technical solution in the field of the sixth or fifth technological order</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Solution may degrade known technology</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Patentability</strong></td>
<td><strong>(y_1.3)</strong></td>
<td>0.25</td>
<td>10</td>
<td><strong>y_{1.3} ≥ 7</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>There is a patent</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Application submitted</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>search for analogues</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>The issue of patenting was not considered</td>
</tr>
<tr>
<td><strong>Economic</strong></td>
<td><strong>y_2 ≥ 9.25</strong></td>
<td>0.25</td>
<td><strong>Net present value</strong></td>
<td><strong>(y_2.1)</strong></td>
<td>0.25</td>
<td>10</td>
<td><strong>y_{2.1} = 10</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Net present value ((NPV &gt; 0))</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(NPV = 0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(NPV &lt; 0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Yield index</strong></td>
<td><strong>(y_2.2)</strong></td>
<td>0.25</td>
<td>10</td>
<td><strong>y_{2.2} = 10</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yield index ((YI &gt; 1))</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(YI = 1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(YI &lt; 1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Internal rate of return</strong></td>
<td><strong>(y_2.3)</strong></td>
<td>0.25</td>
<td>10</td>
<td><strong>y_{2.3} = 10</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>More bank interest on deposits</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Equal to bank interest on deposits</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Less banking interest on deposits</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Payback period</strong></td>
<td><strong>(y_2.4)</strong></td>
<td>0.25</td>
<td>10</td>
<td><strong>y_{2.4} ≥ 7</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Up to 3 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Up to 7 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Up to 10 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Over 10 years</td>
</tr>
<tr>
<td>Types of Efficiency</td>
<td>Criteria for Evaluating Effectiveness in Points</td>
<td>Criteria Weight</td>
<td>The Name of Indicators</td>
<td>Weight of Indicators</td>
<td>Points</td>
<td>Characteristics of Indicators</td>
<td>Recommended values of Indicators in Points</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------------------</td>
<td>----------------</td>
<td>------------------------</td>
<td>---------------------</td>
<td>-------</td>
<td>-----------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Ecological ($y_3$)</td>
<td>$y_3 \geq 8.5$</td>
<td>0.25</td>
<td>Reducing the negative impact of processes ($y_{3.1}$)</td>
<td>0.40</td>
<td>10</td>
<td>No harmful effects</td>
<td>$y_{3.1} = 10$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Environmental Compliance ($y_{3.2}$)</td>
<td>0.30</td>
<td>10</td>
<td>Full compliance with environmental regulations Minor deviation Significant deviation</td>
<td>$y_{3.2} = 10$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Costs for ensuring environmental friendliness and improving work safety ($y_{3.3}$)</td>
<td>0.30</td>
<td>10</td>
<td>Sufficient costs for ensuring environmental friendliness and improving work safety Slight lack of funds Extremely under-invested</td>
<td>$y_{3.3} \geq 5$</td>
</tr>
<tr>
<td>Social ($y_4$)</td>
<td>$y_4 \geq 6.25$</td>
<td>0.25</td>
<td>Increasing the number of jobs in the region ($y_{4.1}$)</td>
<td>0.30</td>
<td>10</td>
<td>Significantly increase work places Fixed quantity Decrease</td>
<td>$y_{4.1} \geq 3$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Improvement in working conditions ($y_{4.2}$)</td>
<td>0.30</td>
<td>10</td>
<td>Coefficient value changes in the proportion of workers employed in conditions that do not meet sanitary and hygienic standards $P_1 &gt; 0$ Coefficient value $P_1 = 0$ Coefficient value $P_1 &lt; 0$</td>
<td>$y_{4.2} \geq 5$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Increasing the level of education of employees ($y_{4.3}$)</td>
<td>0.25</td>
<td>10</td>
<td>The value of the coefficient of change in the number of employees subject to training $P_2 &gt; 0$ Coefficient value $P_2 = 0$ Coefficient value $P_2 &lt; 0$</td>
<td>$y_{4.3} = 10$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Improving the health of workers and the public ($y_{4.4}$)</td>
<td>0.15</td>
<td>10</td>
<td>Reducing the incidence of the population as a result of the project Constant level of morbidity of the population as a result of the project implementation Increasing incidence</td>
<td>$y_{4.4} \geq 5$</td>
</tr>
</tbody>
</table>
The analysis showed that in the implementation of programs in this area competitiveness is usually not evaluated. However, in modern conditions, the need to meet the criteria of technological efficiency is great. Therefore, the authors offer to assess the competitiveness of infrastructure according to the programs of development of the oil industry by all means. The sequence of stages of competitiveness assessment should consist of the following:

1. The choice of the nomenclature of assessment indicators. The indicators used to assess the infrastructural components are determined by the specifics of the infrastructure.

2. Ranking of assessment indicators. The ranking involves the evaluation of the importance of the criteria, allowing for a targeted policy on the creation of modern infrastructure of the oil industry. The importance of the indicators is determined by the introduction of special weighting indicators, the values of which are based on expert assessments.

3. Selection of the comparison base. The study showed that in modern conditions the elements of the best world infrastructure should act as a basis for comparison (the approach currently used, based only on compliance with the best domestic standard, no longer meets the requirements of the oil industry infrastructure development).

4. Calculating partial indicators of the technical level.

This stage provides a direct comparison of each previously selected indicator of the technical level of infrastructure with the benchmark.

Partial indicators are determined by the Formula (2), if the growth of any \( i \)-th criterion contributes to an increase in the technical level of infrastructure, or, according to Formula (3), in the opposite situations:

\[
Y_i = \frac{N_i}{N_{bi}}, \quad (9) \\
Y_i = \frac{N_{bi}}{N_i}, \quad (10)
\]

where \( Y_i \) is the partial indicator of the technical level of the infrastructure of the oil industry for the \( i \)-th indicator, and \( N_i (N_{bi}) \) are the values of the \( i \)-th parameter of the technical level of the analyzed component of the infrastructure (benchmark).

The value \( > 1 \) indicates a higher achieved value of the \( i \)-th indicator compared to the selected benchmark.

5. Calculating partial indicators of the cost of creating the components of the infrastructure.

The partial cost indicator is determined according to Formula (4):

\[
W_j = \frac{3_j}{3_{bj}} \quad (11)
\]

where \( W_j \) is a partial cost indicator for the \( j \)-th infrastructural component; \( 3_j (3_{bj}) \) are the values of the \( j \)-th costs for the analyzed infrastructural component.

6. Determination of the weighting coefficients of indicators characterizing the costs of the infrastructure of the oil industry.

7. Calculating the general indicators of the technical level and costs for the infrastructure of the oil industry.

The calculation is performed to aggregate partial indicators of technical level and partial cost indicators into a generalized evaluation. The summary indicator is a function of the values of partial indicators and their weighting coefficients and is determined by Formulas (5) and (6):

\[
Y = \sum_{i=1}^{n} V_i Y_i \quad (12) \\
W = \sum_{j=1}^{m} U_j W_j \quad (13)
\]

where \( Y \) is a summary indicator of the technical level of the components of the infrastructure; \( V_i \) is the value of the weighting factor assigned to the parameter of the technical level; \( W \) is
a summary cost indicator for the creation of infrastructure; and \( U_j \) is the weighting factor of the \( j \)-th indicator, which characterizes the costs of creating the infrastructural components.

8. Calculating a competitiveness indicator.

The competitiveness indicator (\( \eta \)) is defined as the ratio of the aggregate technical level indicator to the summary cost indicator, see Formula (7):

\[
\eta = \frac{Y}{W} \tag{14}
\]

The infrastructure created under the project should be considered more competitive compared to the benchmark, if \( \eta > 1 \). If \( \eta < 1 \), the infrastructure development project is not advisable for implementation.

The Net Present Value (NPV) is defined as the sum of the current effects for the entire calculation period, reduced to the initial planning interval or as the excess of the integral results over the total costs. If the NPV of an investment project is positive, the project is considered to be efficient (at a given discount rate), and its adoption can be discussed. A positive value of the indicator suggests that the cash flow from the project exceeds the costs of its implementation. The higher the NPV, the more efficient the project is. If the investment project is implemented with a negative NPV, the investor will incur losses, in which case the project is inefficient. Thus, a positive value of this indicator is a criterion for the acceptability of the investment project.

The Profitability Index (PI) is the ratio of the sum of the present effects to the amount of investment costs. If the value of PI < 1, then the project is economically inefficient. The more PI exceeds 1, the higher is the economic attractiveness of the project. This criterion is convenient when choosing one project from a number of alternatives that have approximately the same NPVs (for example, if two projects have the same NPV, but different amounts of required investments, then, obviously, the one that provides greater efficiency of investments is more profitable), or when completing a portfolio of orders with the aim of maximizing the total NPV. In worldwide practice, the corresponding indicator is also called the profitability index.

When making an investment decision, the method of calculating the Internal Rate of Return (IRR) should also be employed. The Internal Rate of Return (IRR) is the rate of interest (discount rate) at which the amount of present effects equals the amount of present capital investment. If the entire project is funded by debt alone, the IRR is equal to the highest interest rate at which you can borrow to be able to make repayments from the proceeds of the project. The decision to invest is made when the IRR is greater than the interest rate on long-term loans.

Preferable are those projects that have higher values of NPV, IRR and, accordingly, a shorter payback period.

The following coefficients are used in the table (to assess social efficiency):

- Coefficient of change in the share of workers employed in conditions that do not meet sanitary and hygienic standards (\( P_1 \)):

\[
P_1 = \frac{(N_{10} - N_{1n})}{N_0} \tag{15}
\]

where \( N_{10} \)—the number of workers employed in conditions that do not meet sanitary and hygienic standards before the implementation of the project (in the base case);

\( N_{1n} \)—the number of employees employed in conditions that do not meet sanitary and hygienic standards, in the design version;

\( N_0 \)—the total number of employees in the base case;

- Coefficient of change in the number of employees subject to training, retraining or advanced training (\( P_2 \)):

\[
P_2 = \frac{(N_{20} - N_{2n})}{N_0} \tag{16}
\]
where \( N_{20}, N_{2n} \)—the number of employees subject to training, retraining or advanced training, respectively, in the base and design options.

The maximum value of the integral assessment is 10 points, while the minimum is 0 points. The authors’ research and calculations make it possible to set the following integral criterion for the programs of oil industry infrastructure development: 8.0 points \((0.25 \times 8.2 + 0.25 \times 9.25 + 0.25 \times 8.5 + 0.25 \times 6.25 = 8.05)\). In this case, the program (project) is efficient.

4. Discussion of the Results

Analysis of the Iraqi oil and gas industry’s production and transport infrastructure has shown its inconsistency with actual existing opportunities offered by the country’s natural resource potential, as well as the domestic needs of the Iraqi economy.

The most important issues of the Iraqi oil industry related to state of its infrastructure are as follows:

1. Production infrastructure:
   - Damage resulting from wars and international sanctions that have affected both refineries and wells;
   - Technological obsolescence of oil refineries and insufficient production capacity;
   - Pollution of the environment in the absence of effective technologies for the disposal of oil wastes [61];
   - Insufficient investments for the restoration, reconstruction of existing production infrastructure facilities and creation of new ones in view of inadequate legislation;

2. Transport infrastructure:
   - Insufficient throughput capacity of ports and railroads as a result of destructions;
   - Instability of transportation due to its insecurity and low level of service.

3. Social infrastructure:
   - Inadequate medical care for potential workforce in oil industry;
   - Lack of national qualified personnel in the field of oil and gas production and management of oil companies, which is not compensated by national educational institutions.

3. The technological infrastructure is of great significance for the competitiveness of the Iraqi oil industry. Technological efficiency, including the assessment of modernity, competitiveness and patentability, must be included in the assessment of the efficiency of the ongoing programs and projects.

4. The social and environmental components are of utmost importance for the development of the modern oil industry as well. When evaluating efficiency, it is necessary to take into account these types of infrastructures and efficiencies.

The developed step-by-step algorithm for managing the development of the Iraqi oil refineries’ infrastructure can be used in oil refinery construction projects that develop industry production potential, contributing to achieving a high economic effect and significantly affect the development of the economy of the region and the country as a whole.

Of major importance for large programs and projects, especially with state support, is the assessment of technological effectiveness, which should include: determining the competitiveness of the technologies provided for by the program and an evaluation of their patentability and novelty. The assessment of novelty, in turn, involves the assignment of technologies to the fifth, sixth or fourth and other obsolete technological modes, to fundamentally new or improved technologies. In addition, it is recommended to additionally assess the degree of adaptability to the organizational and technological level of production and the level of staffing.

If the investment program is properly structured, its effect should surpass the sum of the effects of the projects included. Such synergistic effects arise when mutually influential projects are included in the program due to their joint action (for example, due to the division of labor, joint use of resources). As a rule, the projects included in the program have a common
goal, a single common organizational and economic mechanism of implementation, and the selection of projects in the program should be made by common criteria.

5. Conclusions

Analysis of the Iraqi oil industry’s production and transport infrastructure has shown its inconsistency with actual existing opportunities offered by the country’s natural resource potential, as well as domestic needs of the Iraqi economy. The main problems of the insufficient development of the Iraq oil industry infrastructure are associated with the consequences of political instability, which is pronounced, on the one hand, in the need to restore destroyed infrastructure facilities and, on the other hand, in the insufficiency of Iraq’s own financial resources and the attraction of foreign investment, hindering the development of Iraqi oil refineries. New challenges for the development of the production and transport infrastructure of the oil industry in Iraq are the oil prices slumping, including in the context of the coronavirus pandemic, which not only hinders the achievement of a balance in the state budget but also stimulates the development of renewable energy sources that replace fossil fuels in the electric power industry. The authors see further areas of research in studying digital technological transformation of the Iraq oil industry infrastructure in order to increase its efficiency in the face of new challenges. One of the most important areas for the development of the production infrastructure in the Iraqi oil industry should be the technical reconstruction of oil refineries to ensure the production of motor fuels in accordance with international standards.

The proposed scorecard allows not only for the implementation of the strategy but also for building a mechanism for adjusting the strategic direction of the oil industry infrastructure development on its basis. In unstable conditions, it may be necessary to adjust the strategy through the use of new opportunities or the emergence of threatening factors that could not be foreseen at the initial stage of developing the strategic direction.

The oil industry infrastructure’s strategic development scorecard increases the effectiveness of state regulation of the Iraqi oil industry’s infrastructure development. The involvement of the state as an investor in the investment process is often necessary for the implementation of infrastructure projects. State authorities must be guided by the interests of the entire territory. The authorities can regulate the development of individual industries through support of highly effective commercial projects, distribution of financial flows and centralized credit resources through subsidies and tax incentives. In this process, state investments are the most important element of the investment policy in the sphere of development of the oil industry infrastructure. The budget funds also act as a catalyst to increase the activity of private investors.

As socio-economic, scientific, technical, environmental and other problems emerge and aggravate, requiring for their solution a set of interrelated and interdependent measures and a variety of resource sources, the role of Management by Objectives and target-oriented programs in management will steadily increase. The study showed that the processes of world economic integration and globalization, involving different countries, regions, organizations and social groups, can be coordinated and streamlined on the basis of the application of program methodology.

The analysis has shown that it is necessary to introduce criteria for evaluating the efficiency of oil industry infrastructure development programs and projects, which will assist in rational and supervised implementation of the funding programs, making it possible to spend available resources in a more efficient way, as well as to substantiate the appropriateness of the management decisions made.

Evaluation of efficiency is advisable with a systematic approach, when indicators of the expected performance of targeted programs and projects are reliable and verifiable, when, on the basis of these indicators, compared priorities for spending budget funds are determined and further ongoing monitoring of the achievement of the stated objectives and results is carried out.
On the basis of the conducted research, a consolidated system of indicators, which should be used to evaluate the efficiency of infrastructure development programs in the oil industry, has been established.

Increasing the number of production infrastructure facilities in the oil and gas refining sector and increasing their productivity will help to solve the problem of self-sufficiency of the Iraqi economy in petroleum products; to improve the structure of exports due to partial replacement of crude oil with petroleum products; and to develop petrochemical and gas chemical processing facilities in the oil and gas production areas.

The development of transport infrastructure facilities will not only increase the efficiency of the Iraqi oil industry but will also strengthen Iraq’s geographical position as a link between the East and the West.

The proposed algorithm for managing the development of oil industry infrastructure has a number of advantages. This algorithm allows employing not a large number of indicators, but a limited set of them in the process of development management. At the same time, the indicators are not selected arbitrarily, but on the basis of the methodological approach, which involves the allocation of the necessary strategic projections, in this case—the components of the oil industry infrastructure. The system of indicators in this case is not just a convenient monitoring system, but a strategic management tool, as the model includes programs and projects aimed at achieving development goals. The proposed approach will enable Iraq to develop its infrastructure in the most advanced way, since the selection of the programs is based on a comprehensive approach to efficiency, including economic, technological, environmental and social components. This is especially important for countries where the oil industry is the basis for the development of the whole country, which involves solving a set of not only economic but also social and environmental challenges in society.

Author Contributions: Conceptualization, A.C.; methodology, T.S.; investigation, T.A.-S., A.C. and T.S.; formal analysis, T.S. and T.A.-S.; writing—original draft preparation, T.A.-S., A.C. and T.S.; visualization, T.S. and T.A.-S. All authors have read and agreed to the published version of the manuscript.

Funding: This study was carried out using internal sources of funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References
6. Mohammed, I.M.M.; Pisengolts, V.M. The activities of the oil companies of Iraq and their role in the world economy. Management 2019, 7, 38–46. [CrossRef]


18. Amann, E.; Baer, W.; Trebat, T.; Lora, J.V. Infrastructure and its role in Brazil’s development process. Q. Rev. Econ. Financ. 2016, 62, 66–73. [CrossRef]


29. Glushchenko, V.V. Formation of the Concept of the State’s Transition to Activity in the Conditions of a New Technological Order. Int. J. Sci. Adv. (IJSCIA) 2021, 2, 641. [CrossRef]

30. Samigulina, G.A.; Samigulina, Z.I. Development of theoretical foundations for the creation of intelligent technology based on a unified artificial immune system for complex objects control of the oil and gas industry. J. Phys. Conf. Ser. 2021, 1094, 032038. [CrossRef]


56. Pashkevich, M.A.; Bykova, M.V. Methodology for thermal desorption treatment of local soil pollution by oil products at the facilities of the mineral resource industry. *J. Min. Inst. 2022*, *253*, 49–60. [CrossRef]