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Directions for Increasing Production Along the Value-Added Chain in the Petrochemical Industry of Azerbaijan in the Context of Sustainable Development

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ABSTRACT: In the context of sustainable development in the modern era, the directions of increasing production along the value-added chain in the petrochemical industry of Azerbaijan are being investigated. The role of the petrochemical complex in diversifying Azerbaijan's economy is explained. The effectiveness of developing the petrochemical industry along the value-added chain is substantiated. The importance of creating and developing competitive petrochemical enterprises based on oil and gas processing is stated. The strategic role of petrochemical enterprises in the country's non-oil and gas exports is noted. The possibilities of creating new enterprises along the value-added chain of petrochemical companies are being explored to improve the country's economic structure and increase its export potential. The prospects of creating small and medium-sized plastic processing enterprises based on petrochemical semi-finished products in post-conflict areas are being brought to attention. Proposals are made on the directions of developing petrochemical enterprises in the context of sustainable development.

KEYWORDS: Azerbaijan, sustainable development, petrochemical industry, petrochemical enterprises, added value chain, added production chain, development prospects of petrochemical enterprises, development problems of petrochemical enterprises.

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Introduction

The industrial sector is one of the essential components of the economy of any country. The industrial sector is not only a guarantor of economic growth, but also plays an indispensable role in creating new jobs, introducing technological innovations and increasing the country's competitiveness in the international market. The development of industrial sectors in Azerbaijan is of particular importance, as it is a key factor in strengthening the country's economic independence and accelerating its future development.

Azerbaijan has become a country with a rapidly developing national economy in the region and the world. However, the level of strategic economic goals in our country, which already has a modern economic development model and rich natural and economic potential, must be significantly increased. In particular, expanding industrial potential and more effective use of existing resources are among the priority issues (əliyev, Ş.T., 2017). Currently, Azerbaijan's main sources of income are derived from the oil and gas industry; however, price fluctuations in this sector and global energy market changes expose the country to economic risks. The development of the industry aims to stimulate the growth of other areas, generate income for the country from various sectors, and create conditions for economic diversification. The oil and gas industry is also of great importance in terms of stimulating the development of the petrochemical industry because crude oil and natural gas are the main raw materials of that industry.

Research Aim and Research Questions

The primary purpose of writing the article is to investigate and reveal the possibilities of increasing production based on the added value chain in the petrochemical industry of Azerbaijan, taking into account the criteria of sustainable development in the context of global challenges. In recent years, the efficient use of resources, the formation of savings regimes and the increase in processing capabilities based on high technologies have become relevant worldwide. The development opportunities of the petrochemical industry based on oil and gas raw materials are wide, and the identification of prospects for the added value chain and the implementation of measures in this direction require systematic research. The proposals given in the article can be used in the future to determine the development priorities of the petrochemical industry and create a network of competitive, export-oriented enterprises.

Research Results

Direct export of oil as a raw material to world markets prevents oil-producing countries from obtaining additional income, as it does not allow them to use the full potential of a valuable resource. Therefore, it is more expedient to produce high-quality, competitive and new products from oil and introduce them to global markets. Thus, the development of the petrochemical sector is of strategic importance not only for the world's major oil producers, but also for Azerbaijan, which has rich oil reserves. It is critical to develop this sector in accordance with modern requirements and to approach it systematically (Süleymanov, Q.S., Tağıyev, V.Q., əliyeva, Ş.P., 2024). The petrochemical industry is one of the heavy industries, with its primary purpose being to produce synthetic products and materials derived from oil and natural gas. The products produced in this sector are primarily used as raw materials or reagents in technologically closely related enterprises.

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They are also used as raw materials in various fields, such as the pharmaceutical industry, the production of plastic and rubber products, agriculture, construction, and the production of machinery and equipment. The primary production areas of this industry include enterprises that process raw materials and facilities that produce petroleum products using synthetic materials (əliyev, Ş.T., 2018). The main entities operating in the petrochemical industry are legal entities, their associations and structural divisions, which also carry out the processes of transportation, processing and storage of oil. These entities are participants in ecological and legal relations, since their activities are in interaction with the environment. A characteristic feature of the petrochemical industry, in comparison with other industries, is a high level of automation of labour and the development of technologies, which is associated with the intensification of the use of products of this industry in all sectors of the national economy (Bəxtiyarova, A., 2023).

The creation of a value chain in the petrochemical industry is of utmost economic importance. This process involves converting crude oil and gas into various chemical products, rather than simply exporting them, and processing them in a way that ensures higher income and industrial development. A value chain is the process of adding value to a product at each stage of its production process, from raw materials to the final product. In the petrochemical industry, this is achieved by converting crude oil and natural gas into a range of chemicals and industrial products. Here, the creation of a value chain has a great impact on the country's industrial development, economic diversification, and export potential. Strategic planning, application of technologies, training of human resources, and access to international markets are key factors for successful development in this field.

The value-added chain in the petrochemical industry consists of various stages, which can be divided into the following stages: 1. The stage of raw material extraction based on oil and gas extraction. At this stage, oil and gas deposits are identified through geological surveys, and drilling and production operations are carried out. Crude oil and gas are extracted from the deposits and sent to terminals or processing plants for primary processing. 2. The stage of primary processing is based on the distillation process of oil and gas fractionation. At this stage, crude oil is transported to processing plants via pipelines, tankers or railways, and crude oil is separated into fractions (diesel, gasoline, fuel oil, kerosene, etc.). Methane, ethane, propane, butane and other components are separated from natural gas. 3. The stage of production of basic petrochemical products such as ethylene, propylene, benzene, toluene, etc. The stage of production of basic petrochemical products occupies a strategic place in the value-added chain. At this stage, mainly oil and natural gas are used as raw materials for the production of basic petrochemical products. These raw materials extracted from oil and gas fields initially enter various types of processing plants and are processed. The production of high-value chemicals from crude oil or gas determines the economic efficiency and competitiveness of this sector. The products created at this stage lay the foundation for creating even higher added value in the subsequent stages (production of intermediate and final products). 4. The stage of production of intermediate and final products, which involves the production of plastics, synthetic fibres, rubbers, fertilisers, paints, pharmaceutical components, etc. This stage plays a crucial role in the production of more complex and valuable products utilising various raw materials in the petrochemical industry. This stage itself consists of several main steps,

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and at each step the process of cleaning, recycling or changing the substances in its composition is carried out, which includes: - purchase and primary processing of raw materials. At this stage, the raw materials are distilled, that is, decomposed at high temperatures and divided into various fractions. These fractions form the basis of various chemical substances and materials, cracking and reforming processes. Cracking is the process of converting heavy fractions of oil into lighter and more useful substances. For example, it is used to produce gasoline, diesel and other chemical products. Reforming, as a process used to produce high-octane gasoline, changes the structures of carbon-hydrogen compounds through polymerisation. Polymers (plastics, rubbers, etc.) are produced from raw materials, and in this process, in particular, alkenes such as ethylene and propylene are polymerised and converted into various polymers, which is an important stage for the plastics industry; alkylation and isomerisation. In the alkylation process, new chemical compounds are prepared by adding alkyl groups to alkenes. Isomerisation is the process of changing the structure of substances and bringing them into different isomer forms for the production of synthetic materials. The petrochemical industry mainly produces synthetic materials (for example, synthetic fibres, plastics, and synthetic rubber). These materials are then used in various industrial sectors for the preparation of user products. The semi-finished products and polymers produced at this stage are converted into various final product forms. This can be automotive parts, electrical equipment, materials for the textile industry, packaging materials, etc.; Final product quality control and packaging. Final products are subjected to quality control and inspection processes. This is essential to ensure the product is fit for its intended use and is prepared for packaging, shipping, and sales.

Intermediates are products that are usually derived from basic petroleum fractions (gasoline, diesel, etc.) or raw chemicals (ethylene, propylene, etc.). These products are further processed into higher-value and widely used end products. For example, ethylene and propylene polymerise to form plastics and other chemical materials. As a result, this stage is important for the recycling and conversion of products produced in the petrochemical industry into higher-value products. This has a significant economic impact on the processes and drives the development of the industry. When obtaining intermediates, petrochemical enterprises primarily focus on producing olefins, which are functionalized by removing hydrogen, aiming to create more reactive, unsaturated molecules (Aliyev, S., Gulaliyev, M., Purhani, S., Mehdiyeva, G., & Mustafayev, E., 2024). In addition, some of the low-value by-products produced in these facilities have the potential to add value to the overall system in oil refining. For example, methane and hydrogen gases obtained in steam cracking units are considered to have a higher value in oil refining. Methane can be used as a fuel gas, and hydrogen as one of the raw materials for the production of clean fuels (Alxaslı E.A., 2020). 5. The distribution and sales phase, which involves introducing products to domestic and foreign markets (Алиев, Ш.Т., 2015).

The distribution stage is crucial for delivering products produced in the petrochemical industry to end-users. At this stage, the product is directed from the manufacturer to distributors or trade networks, where the added value is based on several factors: transport-logistics - it is important for the efficient and fast implementation of the distribution process, and for the timely delivery of the product to the market, which requires the presence of quality transport and storage

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infrastructure; distribution networks - petrochemical products are introduced to the market through distributors for use in various fields. A well-organised distribution network increases the market share of the product and creates added value for the company. Logistics and distribution chain, which involve delivering the product to different markets, adapting to regional market requirements, and exporting to foreign markets, are key components of this stage. These facts are important in creating added value because the correct delivery of the product increases customer satisfaction and strengthens the company's market position. The sales stage encompasses the process of presenting petrochemical products to end consumers or companies, where the added value is based on several key factors. Introducing the product to the market, establishing the correct sales channels, and effectively marketing and advertising the product all play a crucial role in creating added value. Various trading networks and internet platforms are the main components of this stage (Агаев, С.Г., Алиев, Ш.Т., 2004); customer relations and services - good customer service and after-sales services create added value. For example, technical support, warranties, and quality assurance regarding the product increase customer satisfaction, which in turn enhances the company's credibility and revenue. Personalised offers and technical support are particularly important for most petrochemical products, as they cater to specific needs. At the sales stage, the adaptation of these products to customers (for example, preparation according to individual requirements or presentation of offers) creates added value; trade relations and marketing - the activities of a strong sales team, advertising and offers tailored to market requirements also create added value at the sales stage. At this stage, effective sales strategies provide a competitive advantage in the market. In general, the distribution and sales stages serve to effectively distribute the product in the chain from production to the market and increase its value. At these stages, added value is created as a result of applying the right strategies, adapting the product to market requirements, and establishing proper customer relationships. In general, at this stage, high-value products are introduced to the world market, and their effective delivery to consumers is ensured.

Products produced at any stage of the value-added chain using more modern technologies have a higher consumer value. They are considered more competitive in the market because they create more added value than other manufacturers. In general, the competitive advantage of a product is measured not by its cheapness, but by its consumer value. In this regard, the concept of competitiveness is of particular importance when examining the value chain. As a result, the analysis of competitiveness allows us to identify the factors that play a key role in the formation of consumer value - that is, in the creation of added value (Məmmədova, N.A., 2022). At each of the stages listed above, the amount of added value increases, but at the final stages, for example, in the production of polymers and high-tech chemical products, this value increases sharply. As can be seen, the added value chain in the petrochemical industry begins with the extraction of raw materials and ends with the preparation of high-tech products. At each stage of this chain, added value is created through technology, efficiency and specialisation (Alguliyev, R.M., Aliyev A.G., Aliyev Sh.T., Shahverdiyeva R.O., 2014).

Strategic planning and investments can make this chain even more valuable and competitive. In addition, centralising corporate governance, optimising costs, and implementing modern digital tools create added value in the petrochemical industry, increasing the competitiveness of these

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industrial enterprises. The integration of oil refining and petrochemical industries into one centre also opens up wide opportunities for creating added value. Proper planning of such integrated facilities promises higher operating profitability. The formation of a consistent approach to growth and strategic development, as well as the application of advanced practices in the operation, maintenance, and supply chain, creates the basis for achieving business excellence. As a result, spare parts management is optimised, agile operations are ensured, human resource development is supported, and the quality of technical service, proper allocation of resources, and economies of scale are realised at a higher level (Alxaslı E.A., 2023).

The development of the petrochemical industry along the value chain and the diversification of production are important conditions, and this process requires the establishment of appropriate infrastructure, the attraction and effective use of qualified personnel, as well as the wider distribution of products in this field on the domestic market. To achieve these goals, it is necessary to implement state support measures (Алиев, Ш.Т. В, 2009). Value chain analysis is a crucial step in the petrochemical industry for increasing production. This analysis serves as a strategic tool for examining the economic activities of enterprises. Its main goal is to identify the most valuable operations for enterprises and to identify areas that can be developed to gain a competitive advantage. This analysis reveals the strengths or current weaknesses of the industry. If the competitive struggle is carried out with a differentiation advantage, enterprises will try to operate more efficiently than their competitors. If the enterprise competes with a cost advantage, then it has the opportunity to make a profit by producing cheaper (Айтжанова, Г.О., Патласов, О.Ю., 2022).

The assessment of the methodology for diversifying production in the petrochemical industry should consider not only economic efficiency but also the potential for strengthening the relationships between the system's elements. Such an approach can be useful for assessing the effectiveness of creating or improving value chains at enterprises. During this assessment, the efficiency of managing raw materials, production processes and sales stages should be taken into account. Increasing the efficiency of the added value chain is crucial for enhancing production in the petrochemical industry. When the value chain is functioning optimally, all the critical processes are performed to provide customers with a highly competitive product or service. One of the leading indicators assessing the efficiency of the value chain of a particular product is the possibility of applying a competitive advantage. To analyse the efficiency of the product value chain, attention should be paid to such issues as the individual links of the chain, the relationships between the links and the position of participants (əhmədzadə, E.N., 2024). In general, diversification of production along the value chain in the petrochemical industry is necessary, which largely depends on the amount of investment. In this area, it is crucial to establish an optimal capital structure and utilise borrowed funds effectively (Алиев, Ш.Т., 2020). The use of debt funds helps enterprises increase the profitability of their own capital. As a result, multidimensional calculations based on these indicators enable the creation of an optimal capital structure and maximisation of net profitability. The role of investment policy for the effective management of existing fixed assets is significant. This policy involves the process of repeated production with constant investments. Diversification of production in the petrochemical industry should also be based on innovations (Piana V., Aliyev, Sh.T., etc., 2009).

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To increase the competitiveness of this industry, which is one of the critical sectors of the Azerbaijani economy, it is necessary to develop it using innovative methods. This approach can also increase the production volume of enterprises, create new jobs, and stimulate the overall development of the country's economy (Керимли, А., 2024). Thus, increasing production along the value chain in the petrochemical industry can be achieved in several directions. These directions involve more efficient use of natural resources and making the product more valuable for the end user, so let's explore their basics—introduction of new technologies and innovation. Introduction of new technologies and innovation increases production efficiency (Алиев Ш.Т., 2008). For example, in terms of increasing production efficiency, highly effective catalysts, less energy-intensive processes, and automated production lines can be utilised. The creation and application of new materials, as well as the development of nanotechnology, can also create higher added value in production processes.

The use of nanomaterials in various fields shapes the future of the petrochemical industry—optimisation of the logistics chain. Proper management of resources at each stage of the logistics chain, optimisation of transportation and improvement of warehouse systems lead to faster and cheaper delivery of products to the market. The establishment of production and processing facilities in some strategic regions increases the speed of production and benefits distributors from proximity to the introduction of digitalisation. Since the petrochemical industry involves highly complex technologies, it is crucial to implement preventive measures to ensure the safe operation of this sector and prevent incidents that could pose a threat to human life. Minimising human intervention plays a key role in the effective and safe management of such production processes.

Additionally, considering these requirements, the introduction and strengthening of digital control mechanisms are of great importance. Digital technologies enable production optimisation in the petrochemical industry (əlizadə, M., 2024). Data analytics and artificial intelligence can be applied to optimise production. With these technologies, production lines can be managed more efficiently, quality control can be strengthened, and market trends can be analysed more accurately. By connecting and real-time monitoring of all equipment and machines in the production process, resources can be used more effectively (Алиев Ш.Т., 2014).

Expanding the product range and creating special products. In addition to traditional petrochemical products, focusing on the production of special-purpose chemicals, including plastics, polymers, synthetic fibres, etc., can develop the added value chain. This will lead to an increase in product quality and market demand. The ecological balance is maintained, and added value is achieved by recycling chemical waste, utilising recycled materials, and implementing environmentally friendly technologies. Expanding cooperation. The petrochemical industry can develop new products and technologies by cooperating with innovative companies in other fields. By establishing closer cooperation with suppliers and integrating them into production processes, it is possible to obtain raw materials at a lower cost and with higher quality. Cooperation and mutual exchange of experiences, benefiting from the expertise of other companies and experts in the field, will strengthen each stage of the added value chain—human resources development. Training and education of the workforce in accordance with the application of modern technologies is also important for creating added value. Training of specialised personnel will increase the quality of

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production. Strengthening branding and market position. Increasing the value of a product is not only about strengthening production, but also about strengthening marketing strategies. Creating a strong brand image and effectively presenting the product's advantages can help it sell at a higher price in the market. Each of these directions will help increase productivity and create new value points at different stages of the value-added chain in the petrochemical industry. Developing strategic approaches in each area will make the sector's future more competitive and sustainable. On the other hand, favourable opportunities will be created for the establishment of small and medium-sized enterprises based on petrochemical intermediates in post-conflict areas (Алиев, Ш.Т., Меликова, Л.А., 2022). Also, new potential will be formed in solving employment problems in these areas (əliyev, Ş.T., 2020).

Conclusions

In general, the petrochemical industry is one of the main directions of economic development for countries with oil and gas reserves:

- However, the direct export of crude oil and natural gas adds limited value to the local economy. In this regard, the deep processing of oil and gas resources into high-value-added products is of great importance in terms of economic diversification and sustainable development.
- Increasing production along the value-added chain promotes technological development and expands export potential.
- Increasing production along the value-added chain in this industry is of strategic importance in terms of economic diversification, export expansion and ensuring technological independence.
- To this end, technological innovations, investment promotion, personnel training and sustainable development approaches should be implemented together;
- In particular, the promotion of deep processing of crude oil and gas, and the establishment of local production of high-value-added products can create the basis for countries to rise to a higher position in the global petrochemical value chain, etc.

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