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Value chain of the refining and petrochemical industries: assessment and strategy integration

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ABSTRACT: The modern concept of value chains is considered. The author developed and adapted theoretical concepts of the value chain concept to the conditions of the national economy of the Republic of Belarus; developed a methodical approach to the analysis of value chains in the oil refining and petrochemical industries, taking into account technology and peculiarities of price formation for oil and oil products; determined the method of identifying the most productive links in the value chain in the refining and petrochemical industries based on the added value indicator; formulated two types of strategies for integrating value chains in the studied industry.

1 INTRODUCTION

The aggravation of competition between manufacturers leads to a constant search for innovations that provide the long-term competitive advantages of an economic entity, as well as its stable functioning in a dynamically changing external environment. The performance of these entities in the refining and petrochemical industries is determined by many different factors, including a balanced value chain.

In modern conditions actualized the problem of constructing a value chain, which, on the one hand, makes it possible to improve the economic entity's own economic efficiency and on the other - does not burden the implementation of it is not characteristic activities and does not reduce the effect of specialization.

The concept of value chains is based on the idea of M. Porter about corporate value chains, as well as on the previously developed concept of supply chains in logistics. As a result of the use of outsourcing by modern industrial companies, a distributed production model has been formed, in which individual technological operations are localized in various regions of the world, which has made it possible to reduce total costs and increase the flexibility of the production process. Thus, the final product is created within the global value chains, where each country specializing in certain technological operations contributes to the value added of the product. The key actors in the industrial sector of the world economic system are not national economies, industries and companies, but global value chains, which are an intermediate form between centrally managed structures and the market.

2 STATEMENT OF THE PROBLEM

The aim of the study is to develop theoretical and methodological guidelines, specific methodologies and practical recommendations on the formation of strategies for integrating value chains, as well as an assessment of their macroeconomic and microeconomic efficiency in the oil refining and petrochemical industries.

3 DESCRIPTION OF THE CURRENT SITUATION

Fundamental provisions of the concept of value chains were formulated by M. Porter (Porter 1985), as well as continued in the writings of G. Gereffy (Gereffi 2001), R. Kaplinsky & M. Morris (Kaplinsky 2002). Foreign scientists-economists P. Grant (Grant 2008), A. Thompson & A. Strickland (Thompson et al. 1998), J. Schank & V. Govindarajan (Schank. et al. 1999.), M. Rother & J. Shuk (Rother et al. 2005), as well as Russian scientists M. Melnik & V. Kogdenko (Melnik 2010), D. Saveliev (Saveliev 2010), S. Tolkachev (Tolkachev 2016), D. Tatarkin & O. Bryantseva & V. Dyubanov (Tatarkin et al. 2014), O. Yuldasheva & O. Yudin (Yuldasheva et al. 2012), L. Maslennikova (Maslennikova 2001.), V. Repin (Repin 2014), R. Khasanov (Khasanov 2009), T. Andreeva (Andreeva 2013) and others made significant contributions to the development of the theoretical and methodological foundations for the formation and evaluation of the effectiveness of value chains.

Practical research in the field of product value chains in certain sectors of the Russian economy is reflected in the scientific studies of S. Avdasheva & I. Budanov & V. Golikova & A. Yakovlev (Avdasheva et al. 2005), N. Rubtsova (Rubtsova 2012), A. Yudaev (Yudaev 2011), T. Andreeva (Andreeva 2013).

Belarusian scientists V. Baynev (Baynev et al. 2015), N. Bogdan (Bogdan 2011), A. Bykov (Bykov 2014.), V. Gusakov (Gusakov 2011), R. Ivut (Ivut et al. 2016), L. Nekhorosheva (Nekhorosheva 2014), T. Kasayeva (Kasaeva et al. 2012), I. Poleschuk (Poleshchuk 2011.), P. Rezkin (Rezkin 2016), D. Rutko (Rutko 2014), V. Fateev (Fateev 1985), V. Shimov (Shimov 2010.), O. Shimova (Shimova et al. 2013), V. Shutilin (Shutilin 2015), G. Yasheva (Yasheva 2009), etc. are also involved in issues of managing value chains and supply chains, as well as network structures in industry.

At the same time, a number of problems associated with the formation of an effective value chain in specific sectors of the national economy are due to insufficient theoretical and methodological development.

There remain debatable questions about the assessment of the effectiveness of value chains and the choice of key activities in their formation.

4 RESEARCH RESULTS

Building an effective value chain, in the opinion of most domestic and foreign scientists and economists, is the most important factor in increasing the competitiveness of business entities and, as a result, the country's economic growth. Taking into account the theoretical research, it can be argued that the value chain consists of consecutive links - activities that are aimed at creating the value of the final product, i.e. product of value to the buyer, and are performed in a chain of economic entities or their units. The main purpose of these activities is to increase the efficiency of the entire value chain or its individual link and maximize long-term profit.

As part of the concept of value chains, the function of participants in the entire value chain is revealed in relations with the external environment (suppliers, consumers) - the transformation of the flow of incoming resources into a valuable product for the consumer. A value chain is a system of interrelated activities, the links between which allow to identify alternative ways of implementation, which can later lead to competitive advantages.

The study summarized and supplemented the classification of value chains for a number of characteristics (Rezkin 2016):

- type of management (managed by the manufacturer or consumer);
- the dominant link (with the dominant supplier/consumer/intermediary/manufacturer);
- the place of the entity in the value chain (supplier, manufacturer, distribution channel, consumer);
- interaction intensity (with high or low interaction intensity);
- the duration of interactions (non-recurring (short-term) or repetitive (long-term) value chain);
- coordination (coordinated, polycentric);

- method of construction and detailing (standard (according to M. Porter), unique);
- type of integration (integrated up, integrated down, fully integrated, specialized);
- scale (individual product, division, individual business entity, industry, global);
- territorial basis (local, regional, national, international);
- ownership (state, private, mixed).

The classification of value chains allowed generalizing and systematizing the theoretical principles of the concept of value chains, as reflected in the works of domestic and foreign scientists, as well as deeper revealing the essence of the category "value chain".

The results of a comprehensive analysis of value chains predetermine the further development of the business entity and industry, as well as contribute to the proper evaluation of competitive strategies in order to increase the efficiency of their activities.

The study of scientific papers in the field of research on the concept of value chains has shown that all existing methods of analysis can be grouped into five approaches (Rezkin P. E. 2016):

1) assessment of the value chain of an economic entity regarding the efficiency and optimality of building a business process system;
2) assessment of the competitiveness of the value chain;
3) assessment of the chain in terms of the cost approach;
4) assessment of the chain from the standpoint of differentiation;
5) assessment of the consumer value of the proposal of a business entity as a result of the functioning of the value chain.

Based on the analysis of existing approaches to the assessment of value chains, it can be concluded that there is no universal methodology for assessing chains of this kind.

The study proposed the use of an integrated approach that will take into account various aspects of the listed approaches to assessing value chains, which will improve the quality and effectiveness of the analysis of value chains, conduct a more complete analysis of the activities of an economic entity and formulate a strategy that ensures its high level of competitiveness and sustainable economic growth.

It is proposed to use value added instead of the currently most common profit as an indicator for assessing the performance of value chains.

The "value added" indicator has a special practical significance in forming value chains and evaluating its effectiveness (Rezkin 2016):

- characterizes the overall efficiency of resource use and takes into account the economic interests of internal (owners, employees) and external (state) participants in the value chain;
- allows you to determine the exact contribution of the employee to the creation of new value in the framework of the value chain and a particular link in particular;
- it makes it possible to improve the system of labor remuneration of an employee through the establishment of the dependence of the size of his remuneration on the value of the added value created (observance of the rule of faster growth of labor productivity over the rate of wage growth);
- allows you to determine and, if necessary, change the share of external contractors (suppliers of material resources) in the value of the product;
- makes it possible to determine the dependence of one link (enterprise) on another within the framework of one value chain;
- allows you to determine the controlling link in the value chain by structural division of its participants (suppliers, producers, consumers);
- prepares a basis for studying the connections between the links of the value chain and their organizational and economic relations in the process of formation and functioning of the value chain in order to increase the efficiency of activities, competitiveness and sustainability of each individual link, as well as identify sources and ways to increase the value of the product (product services) for the end user;
- allows you to resolve issues regarding the construction of a new or improvement of the existing value chain.

A synthesis of methodological approaches to the determination of value added confirms the need and importance of calculating this indicator. Obviously, the added value for each

individual economic entity will be different, but its formation in vertically integrated structures will be much more efficient.

It has been proven that a properly built, productive value chain is the basis for a stable and efficient functioning of an economic entity, industry and national economy as a whole. This concept is one of the key tools in overcoming the existing crisis phenomena in the economy.

The next stage of the research is the application of the concept of value chains to the oil refining and petrochemical industries.

The author conducted a comprehensive analysis of the global oil market and identified trends in its development. Selected factors affecting the price of oil, including: the movement of capital, the demand and supply of oil, geopolitics and natural factors. Assessing the status and trends in the oil refining and petrochemical industries revealed the possibility of applying the concept of value chains in the studied industry, which allowed us to build an industry value chain with the identification of key links, as well as to determine the proportions of the distribution of material flow and the value added value along the chain. The research results allowed to develop the author's methodology for identifying the most productive links in the value chain in the refining and petrochemical industries.

Today, the world oil market is structurally close to the seller's oligopoly. According to the data for 2018, oil buyers are 118 countries of the world community, while major importers - only 10 with purchases of more than 50 million tons (Report on the activities of the Belarusian state concern for oil and chemistry 2018).

Analysis of the world market for oil and oil products has allowed us to build a global oil-producing network based on the flow of crude oil. This network includes four phases:

1) prospecting and mining (ascending phase);
2) transportation and storage (intermediate);
3) processing, sales and consumption (downward);
4) return to the environment (reverse).

The identified features of the material flow in the global oil producing network serve as the basis for building the industry value chain in the oil refining and petrochemical industries (Figure 1).

The built value chain has become the starting point in assessing the state and trends of the oil refining and petrochemical industries in Belarus. In Bearus, a relatively high level of external openness is observed in the studied industry, which is due to the high export orientation and dependence on oil imports.

Calculations showed that the creation of 1 BYN of gross value added in the studied industry requires 1.01 BYN of import costs. The excess of the level of export orientation over the level of import dependence in the oil refining and petrochemical industries indicates a high efficiency of foreign trade, but the value of imports actualizes interest in the problem of import substitution in Belarus.

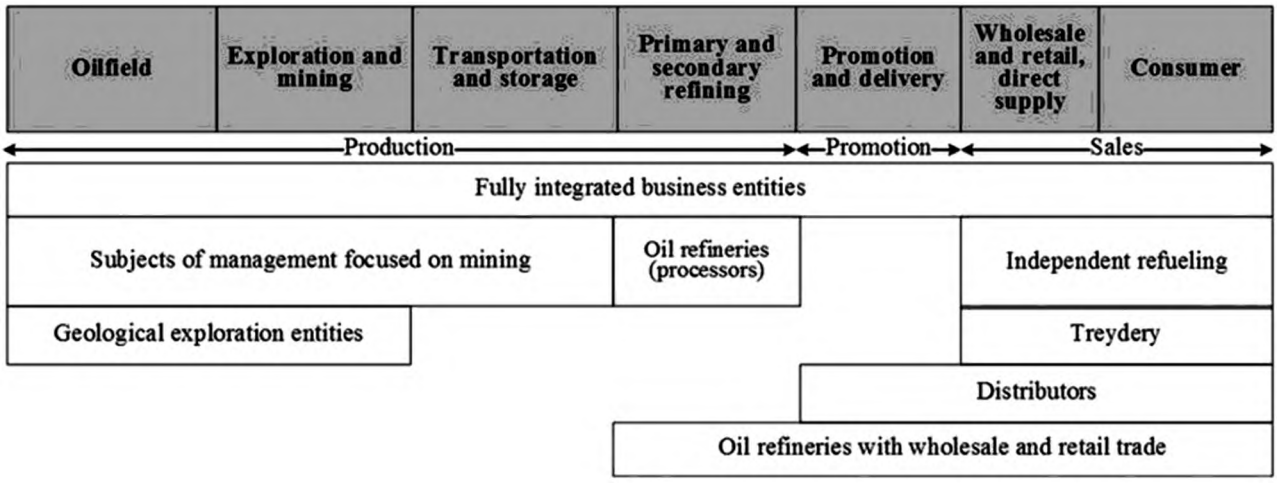

Figure 1. Sectoral value chain in the oil refining and petrochemical industries (author's elaboration).

Analyzing the geographic focus of foreign trade in oil and oil products, it can be noted that the main sales markets for petroleum products according to data for 2018 are Ukraine (25.0%), Great Britain (34.9%) and the Netherlands (13.0%); crude oil - Germany (100%). As for imports, Russia is the main supplier of both oil and oil products for this year (100%) (Report on the activities of the Belarusian state concern for oil and chemistry. 2018).

An important result of the study is the application of the concept of value chains to the oil refining and petrochemical industries. The author has built a valid value chain in the oil refining and petrochemical industry of the Republic of Belarus, the key links of which were primary and secondary refining. Based on the study of the process units of value chains built technological schemes and directions of spending of the incoming raw material - oil. For the first time in the Republic of Belarus, a pattern of distribution of the material flow, as well as the value added across the value chain (Figure 2), has been built.

In order to analyze the existing value chain, the author developed a method for identifying the most productive links in the refining and petrochemical industries, consisting of five consecutive steps.

Step 1. Build a functioning value chain. Identification of key links in the value chain and their interrelation.

Step 2. Constructing the material flow along the value chain – determining the proportion of incoming raw materials (oil) in the finished product.

Step 3. Calculate the value added for each individual link in the value chain. Determination of the share of the value added of each link in the total value added of the value chain.

Step 4. Calculate the coefficient of productivity of the added value of the i-th link in the value chain (I_i^{AV}). This indicator was introduced by us for the purpose of calculating the efficiency of functioning of the links in the value chain.

$$I_i^{AV} = \frac{AV_i}{IRM_i}, \quad (1)$$

where AV_i – the proportion of the added value of the i-th link in the total value added of the value chain; IRM_i – the share of incoming raw materials (oil) in the produced product of the ith link in the value chain.

Stage 5. The ranking of activities according to the coefficients of the value added efficiency of the i-th link in the value chain is made (I_i^{AV}). Based on the method of calculating this coefficient, as well as its economic essence, it is easy to see that the coefficient value is maximized in the case of greater efficiency ($I_i^{AV} \rightarrow \max$), that is, the larger the coefficient value, the more effectively the link of the value chain functions

For the calculations, the author used data from the Belarusian State Concern on Oil and Chemistry, which are in closed access and are a commercial secret of enterprises of the studied industries. For this reason, the study presents only the results, without intermediate calculations.

In the course of the study, the features of the functioning of the value chains in the oil refining and petrochemical industries of the Republic of Belarus were identified, which served as the basis for the formation of development strategies for this industry. It can be stated that the formation of gross value added in the studied industry is largely due to the trade in primary refining products (77.56% of the total gross value added of the industry), while its prevailing part was formed due to export (40.45% of the total gross added value).

In general, the primary oil refining, taking into account sales, provides about 85.42% of the gross value added of the Belarusian petrochemical industry versus 14.03% of the secondary oil refining.

At the same time, most of the gross value added of the secondary oil refining is formed by the scope of production and sale for further industrial use (more than 13.94% of the total gross value added, including 4.45% due to export deliveries), and the sale of consumer goods is only a small part of the gross value added of the industry (0.09%). Based on the distribution of gross value added and material flow throughout the value chain of the industry, the

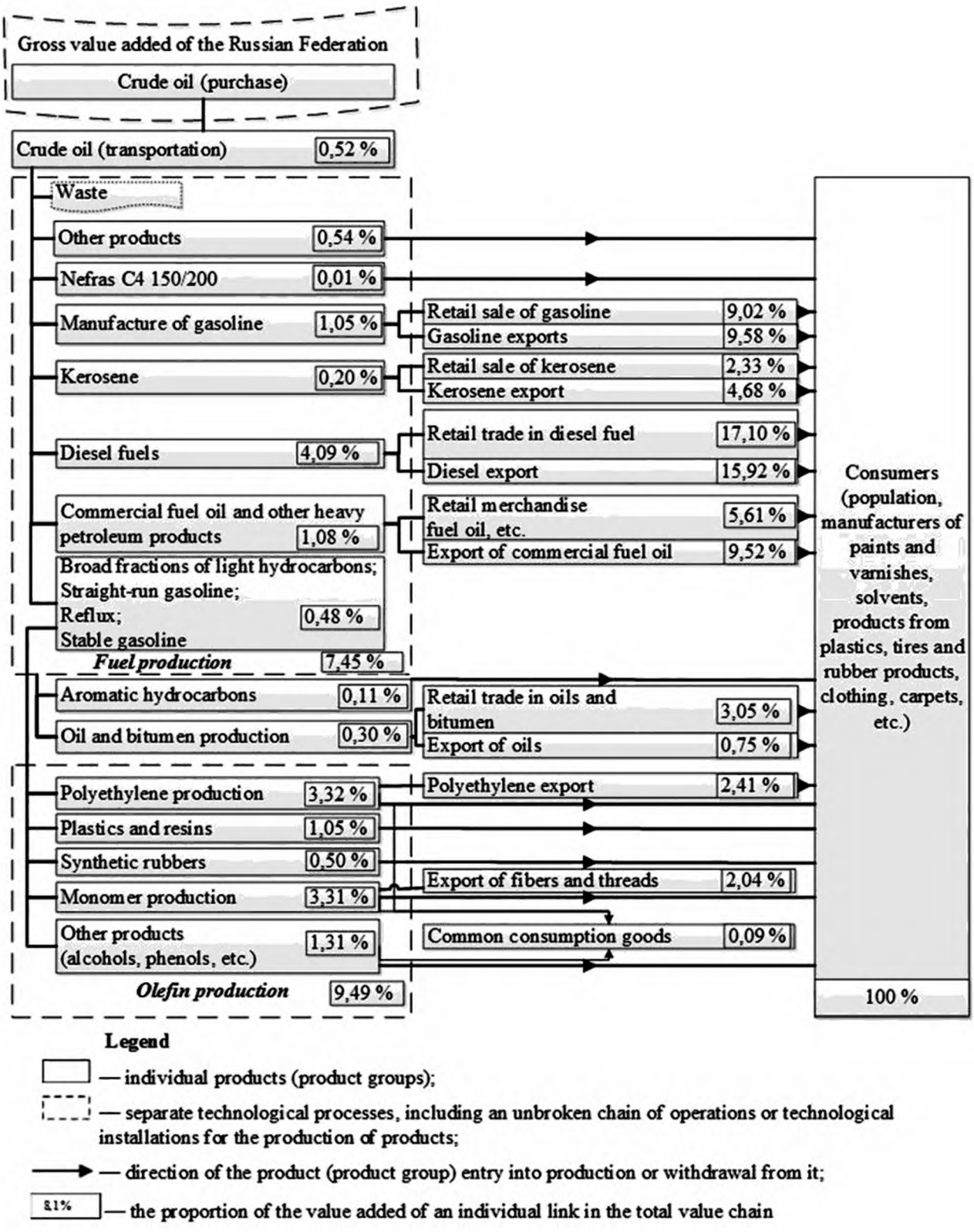

Figure 2. Scheme of value added distribution throughout the value chain in the oil refining and petrochemical industries of the Republic of Belarus (author's elaboration).

coefficients of productivity of the value added of each link in the value chain are calculated and ranked. The calculations were made separately for the production and sales of the products of the refining and petrochemical industries (Table 1).

According to the results of the study, two directions of development of the studied industry can be identified:

Table 1. Ranking of the chains of the value chain of the refining and petrochemical industries by coefficient of productivity for 2018 (fragment, author's elaboration).

	Option 1 (production)		Option 2 (retail and export)	
Rank	Link value chain	I_i^{AV}	Link value chain	I_i^{AV}
1st	Fibers and threads	12,64	Retail trade in oils	2,29
2nd	Alcohols, phenols, etc.	10,45	Export of fibers and threads	2,28
3rd	Methyl acrylate, sulfate ammonium, etc.	8,51	Kerosene export	2,20
4th	Polyethylene	7,52	Export of AI-92 gasoline	2,08
5th	Synthetic rubbers	3,17	Retail sale of kerosene	1,70
6th	Plastics and resins	2,62	Retail sale of other gasoline	1,55
7th	Waxes, dyes, etc.	2,55	Polyethylene export	1,53
8th	Orthoxylol	0,91	Retail sale of gasoline AI-92	1,27
9th	Gasoline AI-95	0,76	Export of AI-95 gasoline	1,21
10th	Diesel fuel	0,68	Retail trade in gasoline Normal-80	1,12
11th	Tulol	0,67	Retail trade in diesel fuel	1,03

1) the development of primary refining in order to sell final products in the domestic and foreign markets;

2) the development of secondary refining in order to manufacture products for further industrial use.

Analyzing these areas, it can be argued that the most promising is the development of primary refining through its deepening, which is due to lower costs when correlated with the value added compared to the second direction, as well as the special interest of the state in primary refining from the position of value added distribution in the form export duties and taxes.

The main paths of development should be energy saving, increasing the depth of oil refining, i.e. processing with the greatest return, production of higher quality products that meet modern environmental requirements, the needs of consumers and the state.

On the basis of generalization, development and adaptation to the realities of the Belarusian economy of the theoretical positions of the concept of value chains, the author has developed a flowchart of the formation of an effective value chain (Figure 3).

Based on the developed flowchart, the author proposed strategies for integrating value chains in the studied industry, namely:

- change of value chains by extending it, which is expressed in the form of reverse ("integration back") and (or) forward-going integration ("integration forward");
- changing value chains through its development (modernization).

The author also developed a system of indicators for assessing the effectiveness and efficiency of functioning of individual links in the value chain (Table 2).

The approbation of this system of indicators was carried out by the author on the example of the oil refining and petrochemical industry of the Republic of Belarus.

5 CONCLUSIONS

This task was successfully solved by the author.

1. The theory of the concept of value chains has been developed and adapted to the conditions of the national economy of Belarus, the use of the value added indicator in the assessment of vertically integrated corporations is justified.

2. A methodical approach to the analysis of value chains in the oil refining and petrochemical industries has been determined, taking into account the technological process and the peculiarities of the formation of prices for oil and oil products.

3. A methodology has been developed for identifying the most productive links in the value chain in the oil refining and petrochemical industries, in which the indicator of value added

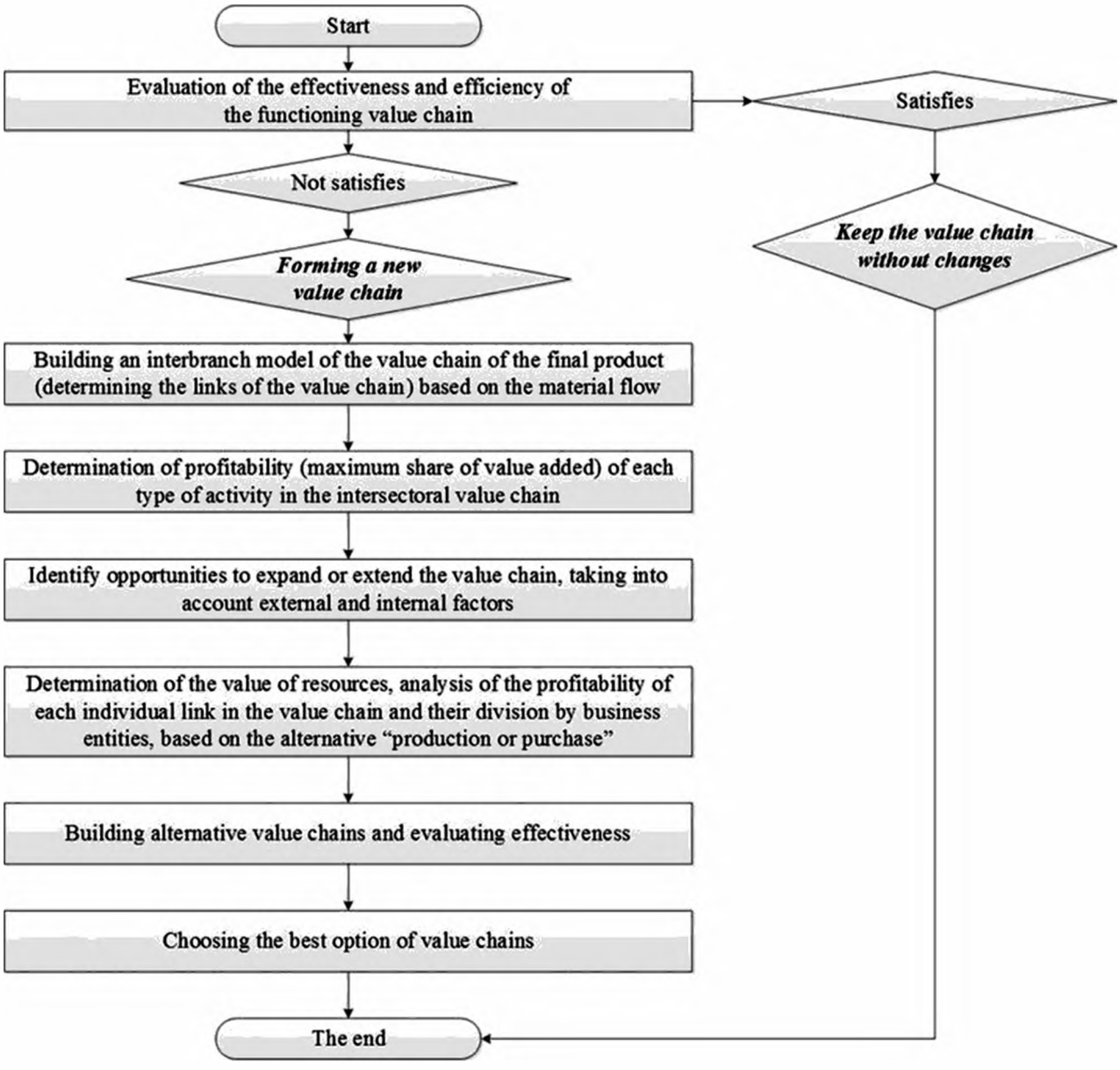

Figure 3. Flowchart of the formation of an effective value chain (author's elaboration).

generated within each process has been used for the first time. The method allows to select the final and intermediate products with the highest level of value added per physical unit of raw materials used. The author has proposed a system of indicators for assessing the effectiveness of individual links in the value chains, which can be used to form a competitive strategy for enterprises and increase competitiveness. This system includes indicators of the structure of value added, indicators of the dynamics of value added, resource efficiency indicators.

4. Differentiated strategies for integrating the value chains of the oil refining and petrochemical industries of the Republic of Belarus are proposed. A distinctive feature of strategies is to focus on maximizing value added

Practical application of the research results allows building an effective value chain for interacting economic entities, thereby increasing their efficiency and competitiveness. The results of the reasearch were introduced into the educational process of the Polotsk State University, tested and used in the activities of Belarusian enterprises of the oil refining and petrochemical industries (Naftan OJSC, Mozyr Oil Refinery OJSC, Steklovolokno OJSC and others), which is confirmed by the relevant acts of implementation in the production activities.

Table 2. The system of indicators for assessing the effectiveness and efficiency of functioning of individual links in the value chain (author's elaboration).

Name of the indicator	Formula for calculating
1. Indicators of the structure of value added,%	
1.1. Proportion of wages (employee income) in the total value added	$\frac{W}{VA}$
1.2. Proportion of depreciation in the total value added	$\frac{DC}{VA}$
1.3. Share of profit from sales in the total value added	$\frac{PS}{VA}$
1.4. Proportion of income of owners in the total value added	$\frac{IO}{VA}$
1.5. Proportion of state revenues in the total value added	$\frac{SR}{MC}$
2. Indicators of the dynamics of value added,%	
2.1. Rate of value added	$\frac{VA_1}{VA_0} \cdot 100\ \% - 100\ \%$
2.2. Rate of wage growth (employee income)	$\frac{W_1}{W_0} \cdot 100\ \% - 100\ \%$
2.3. Growth rate of incomes of owners	$\frac{IO_1}{IO_0} \cdot 100\ \% - 100\ \%$
2.4. Growth rate of depreciation	$\frac{DC_1}{DC_0} \cdot 100\ \% - 100\ \%$
2.5. Growth rate of sales profit	$\frac{PS_1}{PS_0} \cdot 100\ \% - 100\ \%$
2.6. Growth rate of state revenue	$\frac{SR_1}{SR_0} \cdot 100\ \% - 100\ \%$
3. Indicators of resource efficiency	
3.1. Value added per monetary unit of material costs	$\frac{VA}{MC}$
3.2. Value added per monetary unit of sales revenue	$\frac{VA}{SRV}$
3.3. Value added per monetary unit profit from sales	$\frac{VA}{PS}$
3.4. Value added per monetary unit of fixed assets	$\frac{VA}{AVFA}$
3.5. Value added per employee	$\frac{VA}{ANE}$
3.6. Ratio of growth rates of labor productivity and wages	$\frac{R_{LP}}{R_W}$ where: $R_W = \frac{W_1}{W_0} \cdot 100\%$ $R_{LP} = \frac{LP_1}{LP_0} \cdot 100\%$
3.7. Increase in value added per monetary unit of investment costs	$\frac{\Delta VA}{IC}$
3.8. Increase in value added per monetary unit of investment costs	$\frac{\Delta VA}{INC}$

Note. 0, 1 - base and reporting periods, respectively; W - wages; VA - value added; DC - depreciation charges; PS - profit from sales; IO - the income of the owners; SR - state revenues; MC - material costs; SRV - sales revenue; AVFA - average annual value of fixed assets; ANE - the average number of employees; LP - labor productivity; ΔVA - absolute increase in value added; IC - investment costs; INC - innovative costs.

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