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Research of a logistics coordination level in procurement

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Abstract

This study aims to investigate the level of logistical coordination and the state of coordination mechanisms in procurement activities among enterprises involved in supply chains. The research was conducted through a comparative analysis of statistical data obtained from a survey of businesses between July and October 2021.The study proposes a method for identifying general and individual performance indexes for partner companies' interactions by examining joint planning, synchronized documentation, coordinated operational procedures, and resource integration. This method is relevant to both logistics theory and the practical activities of supply chain participants. The research highlights the evolution of metrics used to evaluate the extent of coordination mechanisms employed by businesses in their procurement activities. Based on the selection criteria, an assessment scale is proposed to determine the level of logistical coordination in supply chain companies' procurement activities. The findings offer insights into the development of coordination mechanisms for organizations across various sectors (industrial, trading, freight forwarding), focusing on their scientific significance and impact on the competitiveness of consolidated supply chains. This study contributes to the literature by providing a comprehensive understanding of logistical coordination and coordination mechanisms in procurement activities among supply chain enterprises, as well as offering a practical assessment scale for evaluating logistical coordination levels.

Keywords: Coordination mechanisms, Joint planning, Management by procedures, Procurement, Resource integration, Supply chain partnerships.

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1. Introduction

The trend of the modern market is that rapidly, continuously, and often unpredictably changing conditions of interaction between participants in supply chains determine increased requirements for the formation of a system of mutually beneficial relations between suppliers and consumers that is based on a variety of coordination mechanisms. According to several scholars and practitioners, today logistics coordination has become one of the most effective tools for the improvement of competitiveness of not only individual enterprises but also the full chain supplies of both domestic and international markets [1].

The interpretation of the essence and main directions of logistics coordination development in the works of Russian and foreign scientists is presented from different points of view. The first point of view presupposes that inter-organizational logistic coordination is an integration of goals and actions (plans, forecasts, processes, indicators) of supply chain participants based on the application of a systematic approach, the concept of total costs, and, most importantly, the equitable distribution of benefits resulting from joint activities of partner enterprises [2-7].

Both marketing scientists and experts in the field of logistics management emphasize the close relationship between logistics coordination and the system of continuous and rapid exchange of relevant information between enterprises of the same supply chain [8, 9].

Currently, the ideas that coordinate the procurement process participants' activities are perceived and developed at a new level in the SRM (supplier relationship management) concept created to improve the procurement process by enhancing the supplier search and selection procedure (and, at the next stage, build an effective scheme of interaction with them) [10-13].

SRM is becoming increasingly relevant in the buyer-supplier dyad as a result of changes in the global supply chain environment [14]. These changes, includes changes in the structure of demand and government policy, inflationary pressure, and exchange rate fluctuations, among other things, which create supply uncertainty [12] for example, during periods of high supply uncertainty, strengthening relationships with suppliers creates potential benefits, such as gaining access to the required materials, reducing transaction costs, etc. [14-16].

Companies are seeing the necessity to outsource non-essential tasks as the business climate becomes more competitive, while focusing most of their resources and talents on core competencies. [17]. In connection with the development of outsourcing, the role of SRM is increasingly growing, since using this approach allows firms to respond to dynamic and unpredictable changes in the business environment [12, 18, 19].

Various coordination strategies are widely used in real business. They are used by companies such as International Business Machines (IBM), Sun Microsystems, Hewlett Packard, Nippon Otis [20] Toyota Motor Corporation, and the multinational Tata group [21, 22].

Our point of view on the coordination of procurement activities at enterprises as the unity of goals and actions demonstrated by participants in the procurement process is based on the use of end-to-end logistics management. The starting point of interaction between suppliers and consumers within the framework of management concept should be the development of partnerships between participants based on the use of mechanisms of joint activities and joint planning, harmonization of management documentation, coordination of operational procedures, resource integration, and staff motivation for uniform end results (maximum compliance of procurement, production and sales processes). In these conditions, the assessment of the following circumstances becomes especially relevant for partner companies:

- At what stage of the development of relations with suppliers is the enterprise?
- What is the level of coordination with different categories of suppliers?

What priority coordination mechanisms (in terms of their influence on the final result) are advised to use in cooperation with the suppliers (at different stages of the relationship with them, for different categories of purchased goods and services)? However, the writings of contemporary authors do not offer a thorough comprehension of these issues, making it difficult to judge the supply chain players' competitiveness potential and determine whether further research is necessary.

2. Methods

It is important to develop an aggregate indicator of the coordination mechanisms in order to conduct a thorough quantitative and qualitative assessment of the level of logistic coordination between partner enterprises based on how companies use these mechanisms (in their interactions with various categories of suppliers) and how much of an impact they have on the output of the work done by production, trade, and transportation enterprises (K_{lk}).

In turn, solving this problem requires a preliminary estimation of *individual parameters that* reflect the level of the use of *certain* coordination mechanisms in the relationship with suppliers (K q (q = 1... 7), namely:

2.1. The Indicator of Process Coordination

- Joint planning (K 1).
- Harmonization of guidance documents in the field of procurement process management (K 2).
- Coordination of operating activities (procurement procedures) (K 3).
- Employee inspiration for the project's overall outcomes and collaboration with partner enterprises (correspondence of purchases and sales) (K 4).

2. 2. The Indicator of Resource Integration

Joint use of material (K 5), informational (K 6), and labour resources (K 7) to regulate procurement.

Determining a parameter that enables one to ascertain the actual condition of a particular coordination mechanism (q) in the procurement operations of firms in the supply chain is therefore given priority in the proposed system of indicators, as is evident from the above.

For this purpose, at the first stage of calculations, individual indicators reflect the level of use of each coordination mechanism (K_q) are estimated:

$$K_q = \sum_{j=1}^{m} \left(D_q \, \mathrm{x} \left(N_q - P_q \right) \right)_j \qquad (1)$$

Where K_q is an individual indicator showing the level of use for the q-th coordination mechanism in the procurement activities of the company (points).

D_q is the *share of joint projects* with suppliers for the q-th coordination mechanism in the total volume of procurement (share).

N_q is the *effectiveness* of projects related to the use of the q-th coordination mechanism in the procurement activities of the company (expert data expressed in points).

P_q is the *losses* from the implementation of projects associated with the use of the q-th coordination mechanism in the procurement activities of the company (expert data expressed in points).

q is the symbol (number) of the coordination mechanism (q = 1... 7).

m is the number of partner suppliers using the q-th coordination mechanism (units).

j is the number of the partner supplier (unit).

Thus, as follows from the formula (1), the calculation is based on the evaluation of two basic parameters, allowing determining *the actual status of each of the coordination mechanisms* in the procurement activity of partner companies: *performance* (N_q) reflecting the positive effect from interaction with partner enterprises and *loss* (P_q) from using the q-th coordination mechanism. It means that in assessing the actual state of each specific coordination mechanism, it is necessary to consider not only the positive effect of interaction but also the costs associated with this process, particularly damage from unprofitable projects of joint activities (manifestation of various types of losses in the process of interaction partner enterprises).

At the next stage, we can determine the aggregate indicator of the level of coordination mechanism use (K_{lk}):

$$K_{lk} = \sum_{q=1}^{n} K_q \qquad (2)$$

Where K_{lk} is the aggregate indicator of the level of coordination mechanism use in the procurement activities of the enterprise (points).

K_q is an individual indicator of the level of q-th coordination mechanism use in the procurement activities of the company (points).

n is the number of coordination mechanisms (7).

q is the number of the coordination mechanism (q = 1... 7).

The reported values were approximated based on a comparative analysis of statistical data for the group of companies surveyed from July to October 2021. The survey included 57 enterprises both from Russia and abroad operating in the Russian market. Among them, there are manufacturing enterprises (automotive, pharmaceuticals, light industry, food industry, and construction industry), trading companies, transport, forwarding companies, and warehouse operators.

In the research, we used factorial, statistical, and comparative analysis, as well as the methods of peer review, questionnaire, and comparison by analogy.

3. Results and Discussion

In order to assess the degree of use of coordination mechanisms in the relationships of the examined organisations with various categories of suppliers, aggregate and individual indicators were calculated based on the available data. As the results showed, the values of the aggregate indicators of the level of the use of coordination mechanisms at the enterprises under study (K_{lk}) have significant fluctuations, which does not allow one to unambiguously judge the level of logistical coordination of the respondents. In this regard, for a comprehensive assessment of the situation, we carried out an additional analysis of the study participants according to qualitative criteria, in particular: the coordination strategy used, the potential for interaction with various categories of suppliers, the priority of using coordination mechanisms at different stages of the life cycle of relations with suppliers, the share of partners, the ratio of successful and unprofitable projects, and the productivity of investments in the development of partnerships with suppliers. The work carried out allowed us to segment the companies into four groups and, at the next stage, draw conclusions about the tendencies in the development of coordination mechanisms in organizations of various fields of activity: production, trade, transport, and forwarding.

The *first group* (high K_{lk} values, use of a partnership strategy of relations with key suppliers, high potential for cooperation and joint development of counterparties) includes 25% of companies. A slightly larger amount is made up of the enterprises of the second group (average, stable level of use of coordination mechanisms). The largest share (32%) is taken by the third group of companies having low values of the specified indicators. Just over 12% are taken by the participants from the fourth group showed practically zero or negative results.

The best results (from 10.7 to 20.5 units) are typical for foreign manufacturing and trading companies operating in the Russian market. Food industry enterprises are in the lead position (their values are 13-20.5 units) among the manufacturing companies with the highest K_{lk} indicator values and quality parameters.

To conduct a meaningful assessment of companies we see it fit to highlight the *similarities of leading enterprises:*

- Use of a partnership strategy of interaction with strategic suppliers (long-term relationships with a limited number of partners on the principles of cooperation and joint development) and a competitive strategy in relations with basic and contract suppliers (independent nature of relations and the absence of long-term obligations of the parties).
- The number of strategic partner suppliers of such companies is about 20% of the general pool of suppliers. Over the past 3 years, there has been a clear desire of leading enterprises to actively develop partnerships with strategic suppliers; their growth over the specified period amounted to about 12%.
- High potential for joint development, including parties' mutual interest in coordinating purchases, focus on strategic development; use of advanced methods and technologies useful for both the client and the supplier, financial stability of partners, developed logistics infrastructure, own transport and storage facilities allowing both parties to reduce costs; lack of information about the regular supply-side compliance violations by both the supplier and the consumer. Moreover, the contractual obligations for supplies, the existence of litigation, the accessibility of counterparties, the simplicity and convenience of communication between the parties (saving resources, time, and energy), the expertise of staff on matters relating to prompt deliveries, the provision of operational information, etc., and a comparable degree of economic development for both business partners.
- The share of joint work with various categories of suppliers in the total volume of procurement activities of such companies was on average 30-35%. These are direct purchases of material resources for production and trade.
- According to the experts in the companies of the first group for the past 3 years, the overall ratio of effective and loss-making projects of joint activities amounted to 70-90% (productive) and 10-25% (loss-making), respectively.
- Priority assessment of use for different coordination mechanisms confirms our data Figure 1. The largest share in the joint activity takes the interaction between the first group of companies within the framework of joint planning mechanisms and the harmonization of guiding documentation in the field of procurement. In terms of the overall volume of cooperative work with suppliers, these techniques are often used between 70 and 90 percent for joint planning and 80 and 100 percent for harmonisation. Accordingly, company experts rate the effectiveness of applying these techniques at 9 to 10 (10-point scale), whereas losses are only given 2 to 2.5 points.

The least important for the companies of the first group over the past 3 years was the use of motivation mechanisms and the joint use of material and labour resources. The average shares of the use of these mechanisms in the total volume of joint work with suppliers were: 15, 10, and 17%, respectively.

The experts assess the effectiveness of these mechanisms as low (on average, from 1 to 4 points), while losses are described as significant (up to 7 points).

As follows from Figure 1, even leading companies have negative values of individual indicators Kq. This is due to the fact that joint activities on some of the mechanisms used over the past period have not justified themselves. As a result, the losses exceeded the effectiveness. In such circumstances, companies are limited to using only those areas of cooperation (and only with the main strategic) suppliers that bring tangible end results considering it inappropriate to fragment resources in many other areas of interaction. For example, one of the surveyed food industry companies used in its purchase activity only mechanisms for joint planning, harmonization, and alignment of the operating procedures (but at a sufficiently high level: the performance values are estimated at 10, 9, and 6 points, respectively) has a profit gain of 10% and an increase in the completed order share by 23% last year. Another enterprise, a Russian wholesale trading company, uses three mechanisms that give the greatest return in relations with strategic suppliers: joint planning, coordination of operational procedures, and the use of single information space (performance values are 10, 8, and 7 points, respectively). Against this background, the increase in the company's profit over the past year amounted to about 1 %, and the share of the completed order increased by 40%. In this case, the majority of the companies surveyed use the resource integration mechanisms (sharing tangible and labor resources) at a minimum level, regarding them as high-risk.

However, analysis of the main parameters of purchases by the companies of the first group (in conjunction with the level of usage of coordination mechanisms) allows us to conclude that working together with the partner enterprises had a different impact on the purchase indicator dynamics for these companies. The greatest effect was observed in terms of the share of completed orders indicator (75% of companies had an increase of 30%), as well as in terms of the indicators of the level of coordination of procurement and sales plans, volume, and flexibility of purchases. According to these parameters, half of the companies in the first group had an increase of 30-35%. Several indicators in 50-75% of the companies remained virtually unchanged; this shows the importance of *the integrated* use of coordination mechanisms Table 1.

The mid-level values of the K_{lk} indicator (from 3.8 to 8.6 units) are demonstrated by enterprises of the *second group,* the share of which in the total of the companies studied Table 1 is slightly more than 30%. Among them, there are Russian distributors, Internet trading companies (wholesale trade, distribution), Russian and foreign transport forwarders, and warehouse operators.

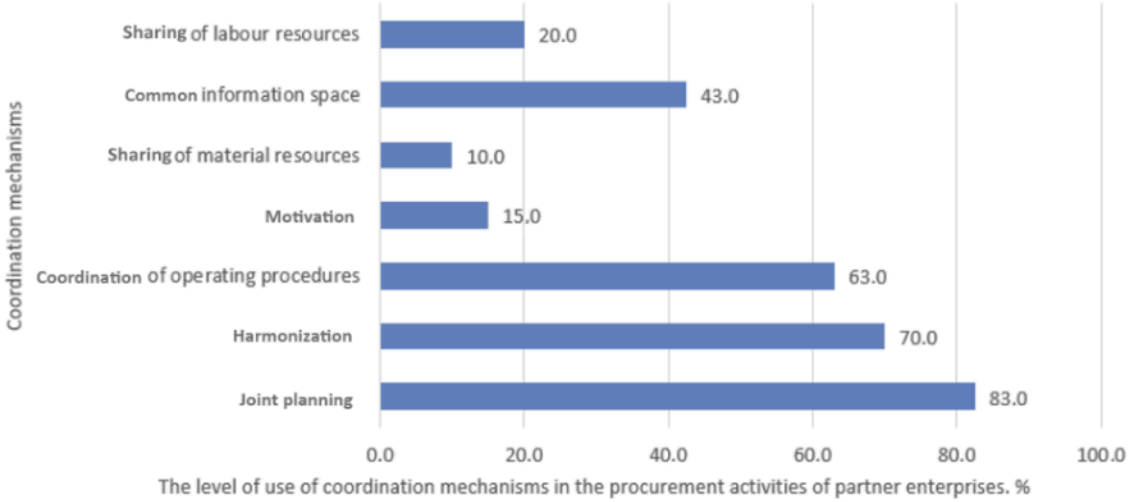

Figure 1.
Diagram of the level of coordination mechanism use by companies of the first group for the last three years (As of October 1, 2021, average values for the first group of enterprises).

Table 1.
Dynamics of indicators of enterprises of the first group over the past three years as a result of the use of coordination mechanisms (As of October 1, 2021).

Indicator	Indicator without change– A/B	Growth of the indicator – A/B	Reduction of the indicator – A/B
Share of orders completed	0/25	30/75	0/0
Procurement cycle duration	0/75	0/0	20/25
Procurement costs	0/25	17.5/50	10/25
Volume of purchases	0/50	35/50	0/0
Level of harmonization of plans on purchases and sales	0/50	30/50	0/0
Level of dependence on suppliers	0/50	10/50	0/0
Share of breaches of obligations to suppliers	0/50	0/0	15/50
Procurement flexibility	0/50	30/50	0/0
Safety loss risks	0/50	20/25	30/25

Note: A/B, where,
A – Dynamics of the indicator (Increase, decrease, no changes) (%).
B – The share of companies in their total number (%).

As the analysis shows, these companies are characterized by:

- Elements of partnerships with strategic suppliers (collaboration but no joint development).
- The quantitative proportion of partners in the general pool of suppliers does not exceed 8-10%. The growth over the past 3 years has been from 5 to 7%.
- The share of joint work with basic partner suppliers in the total volume of procurement is on average 23%. The majority of the time, it refers to the direct purchases of finished goods by wholesale trade businesses for final realisation in retail trade networks, the indirect acquisition of materials and equipment, as well as the acquisition of goods services for transportation and warehousing by goods forwarding firms;
- The ratio of successful and unprofitable joint venture projects over the past 3 years was, respectively: from 20 to 50% (effective) and about 10% (unprofitable).
- Among the enterprises of the second group, the joint planning mechanism was developed most actively (the share of its use varies from 20 to 90%; when assessing its effectiveness, its average value was 9 points, and for losses – 1-2 points on a 10-point scale). The harmonisation of operating procedures with partners came in second in terms of performance, but its contribution to the overall volume of joint activities of this group of enterprises was just 2 to 4%. Figure 2. Interaction with suppliers in the field of the formation and use of a unified personnel motivation system, as well as in the direction of resource integration, except information) for the companies of the second group over the past 3 years has minimal values.
- The dynamics of procurement indicators concerning the level of use of these mechanisms for the enterprises of the second group is most obvious in terms of the parameter of the proportion of violations of supply obligations. Its positive dynamics were noted by more than 40% of companies in the second group. The average reduction in the share of violations of supply obligations was 30% Table 2.
- Mid-level values take place in terms of the share orders of completed indicator. An increase in this parameter of purchasing activity of 20% over the past three years was demonstrated by approximately 25% of companies in the second group. For other indicators, the results are more modest. In particular, the duration of the order cycle decreased (on average, by 15%) in only 20% of the surveyed companies of the second group. The same number of enterprises had an increase in the volume of procurement activities (on average by 10%). However, procurement

costs increased by the same amount. In addition, about 40% of companies over the last year noted a 20% increase in their procurement flexibility and acceleration in the turnover of working capital (on average, by 15%).

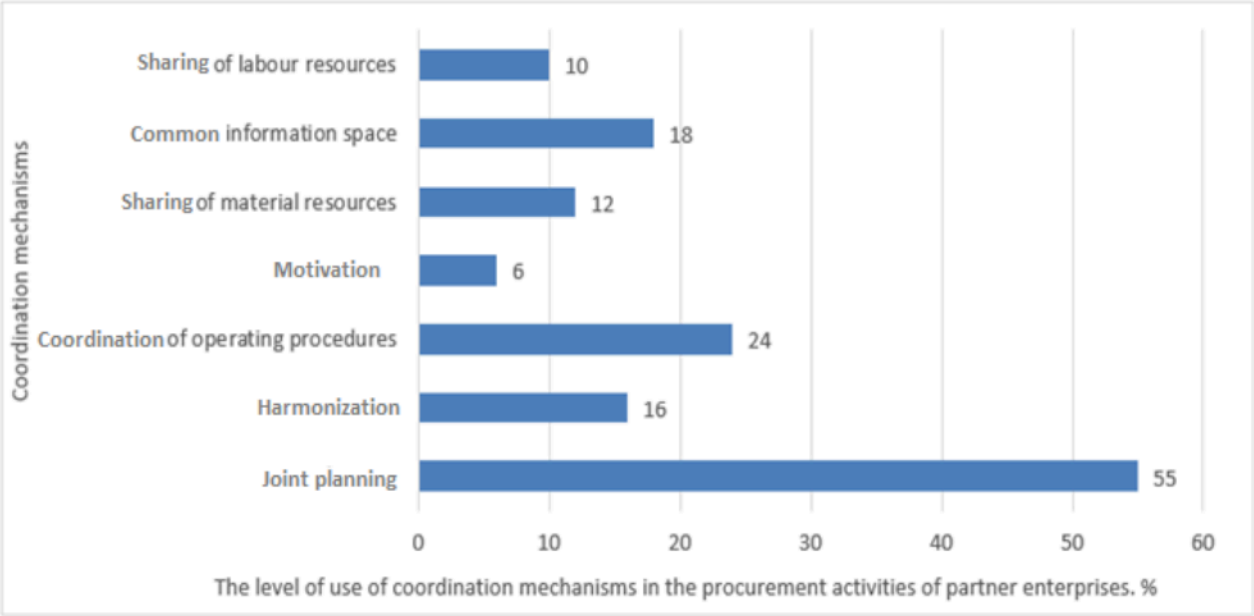

Figure 2.
Diagram of the level of the coordination mechanism use by companies of the second group for the last three years (as of October 1, 2021, average values for the 2nd group of enterprises).

Several indicators have not changed. In particular, there were no dynamics (or these changes were insignificant) in terms of the average level of stocks, the accuracy of price forecasting, risks of dependence on suppliers, etc. For example, the decrease in the average level of stocks took place less than in 5% of companies not exceeding 10%.

Thus, the mechanisms for joint planning and coordination of operational procedures caused the greatest impact on those indicators of second-group enterprises that directly reflect the results of the procurement operations from the perspective of order completion.

Table 2.
Dynamics of indicators for the 2nd group enterprises over the past three years as a result of the use of coordination mechanisms (As of October 1, 2021).

Indicator	No change – A/B	Increase – A/B	Decrease – A/B
Share of orders completed	0/75	20/25	0/0
Procurement cycle duration	0/80	0/0	15/20
Procurement costs	0/80	10/20	0/0
Volume of purchases	0/80	10/20	0/0
Level of harmonization of plans on purchases and sales	0/80	27/20	0/0
Level of dependence on suppliers	0/100	0/0	0/0
Share of breaches of obligations to suppliers	0/60	0/0	30/40
Procurement flexibility	0/60	20/40	0/0
Safety loss risks	0/100	0/0	0/0

Note: A/B, where,
A – Dynamics of the indicator (Increase, decrease, no changes) (%).
B – The share of companies in their total number (%).

The analysis of enterprises from the largest *third group (which* accounted for 32% of the total database of the companies studied) shows fluctuations in the actual level of use of coordination mechanisms in their relations with basic suppliers within the range from 0.8 to 2.4 units. This group includes Russian manufacturing and construction companies, as well as Russian transport suppliers, who were using a competitive supplier relationship strategy. The quantitative proportion of basic suppliers, in relations with which certain elements of cooperation are applied, in a general database of suppliers from the third group of enterprises is no more than 3-4%, with an increase over the past 3 years, on average, to 1.5%. The share of joint work with basic suppliers in the total volume of procurement activity is about 12%. Indirect purchases of feasibility studies, maintenance, certification, etc. are also common. These include direct purchases of raw materials, building materials, and carrier services.

Coordination mechanisms are still not actively used by enterprises of the third group Figure 3. The greatest development over the past three years has been achieved in joint work with basic suppliers in the direction of harmonizing operating procedures (22%). The share of using joint planning and harmonization does not exceed 17%. For the rest of the coordination mechanisms, the values are minimal: 5% for motivation and for resource integration, respectively: material resources – 10%, information resources – 7%, and labour resources – 9 % (used by about 25% of companies in the third

group). Evaluation of *performance* (from the point of view of the third group companies' experts) is also low and does not exceed (according to most coordination mechanisms) 3-4 points on a 10-point scale. Losses are defined as more significant: from 3 to 7 points. In connection with these circumstances, the total value of the K_{lk} indicator (the level of use of coordination mechanisms) for the companies of the third group is minimal (does not exceed 2.4 units).

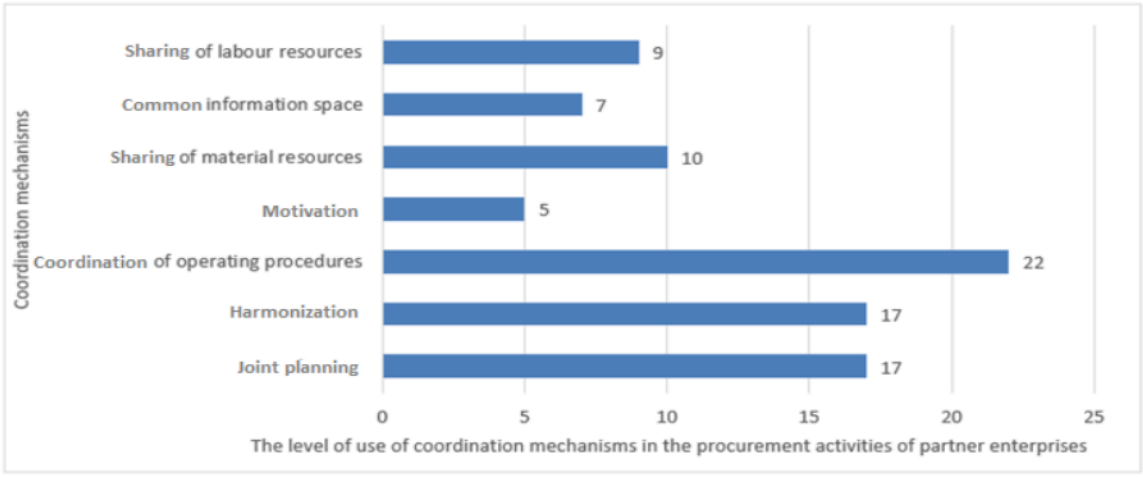

Figure 3.
Diagram showing the level of use of coordination mechanisms by the third-group companies for the last three years (As of October 1, 2021), the average values for the third-group enterprises.

This tendency is confirmed by the analysis of the state of the purchasing activity indicators for the companies of the third group Table 3.

The highest values are observed for the indicator of the level of consistency of plans for purchases and sales: 75% of companies experienced a certain improvement in this indicator by 15% on average. A similar result was demonstrated by half of the companies in the third group in terms of the accuracy of price forecasting. Intriguing estimates were presented by the experts concerning the indicators of procurement activity and costs. While the volume of purchases made by 75% of companies over the past period increased (by 15% on average), procurement costs from half of the surveyed enterprises decreased by about 10%. This should be attributed to the increase in efficiency of joint activities with suppliers in the area of prompt coordination of operational procurement functions and procedures.

The values of other indicators of enterprises of the third group are not high. Thus, only half of the companies noted an increase in the share of completed orders (however, of less than 10%). The duration of the order cycle was reduced by less than 7% and only in 23% of enterprises. Inventory levels for 82% of companies remained unchanged; while for 18%, they decreased by less than 13%.

Experts from none of the analysed organisations noticed any positive dynamics whatsoever when looking at the indicators of the percentage of supply obligations and procurement flexibility. There are mixed assessments in terms of risks of security loss. 25% of companies indicated an 8% decrease, while another 25% indicated an increase of similar size. In this regard, the level of dependence on suppliers is regarded as contradictory: 50% of companies over the past three years have observed an increase in this indicator (15%), and 25% – its decline (by 20% on average). Another 25% of enterprises did not notice any significant dynamics at all. As the analysis shows, the increase in the studied indicators took place in those enterprises, the volume of purchases of which has steadily increased over the past three years (from 10 to 30%). The studied indicators generally changed by the same amount in response to increases in procurement activity of 10%; however, when purchases increased by 30%, they exhibited average 15-20% dynamics (i.e., they became less responsive to changes in the volume of economic activity). In addition, almost all companies that noted the dynamics of the studied indicators actively interacted with suppliers within the framework of resource integration mechanisms. Thus, all of the above allows us to conclude that the joint use of material resources by partner enterprises, work within a single information space, as well as the involvement of partner personnel to perform procurement functions, on the one hand, affect the increase in procurement volumes. On the other hand, this leads to increased dependence on suppliers and, accordingly, additional risks of loss of security.

Companies of the *fourth group* demonstrate practically zero values of the K_{lk} indicator (their share is just over 12% of the total of enterprises that took part in the study). These are Russian manufacturing enterprises operating based on a competitive relationship strategy and they have practically no partnerships with suppliers. The process of direct and indirect procurement of raw materials, consumables, and equipment to support the main activities is carried out by these companies independently within the framework of the traditional scheme for determining the need, selecting suppliers, concluding contracts, processing, receiving, and paying for orders. As the expert assessment showed, the enterprises of the fourth group used at the minimum level certain elements of joint planning and resource integration, in particular, attracting suppliers' personnel (their share did not exceed 1-2% in the total volume of procurement activities). However, the effectiveness of such interaction was noted by experts as zero. In several cases, the losses even exceeded from the obtained effect, which is confirmed by the indicators of procurement activities of the companies in question. In particular, despite the fact that the majority of the enterprises in the fourth group's specialists gave them a 9 to 10 point rating on a scale of 10,

the most significant indicators included the percentage of orders that were completed, the length of the procurement cycle, the cost of the purchases, the turnover of working capital, the degree of coordination between the plans for purchases and sales, etc. However, none of the companies of the fourth group showed positive dynamics for any of these parameters over the past period. According to the indicators of share of violations of supply obligations, the average level of stocks, and some others, negative dynamics took place (an increase of 10% on average).

Table 3.
Dynamics of indicators of the third group enterprises over the past three years as a result of the use of coordination mechanisms (As of October 1, 2021).

Indicator	No change – A/B	Increase – A/B	Decrease – A/B
Share of orders completed	0/50	10/50	
Procurement cycle duration	0/75		10/25
Procurement costs	0/50		10/50
Volume of purchases	0/25	15/75	
Level of harmonization of plans on purchases and sales	0/25	18/75	
Level of dependence on suppliers	0/25	15/50	20/25
Share of breaches of obligations to suppliers	0/100		
D flexibility procurement	0/100		
P safety loss claims	0/50	10/25	10/25

Note: A/B, where
A – Dynamics of the indicator, (Increase, decrease, no changes) (%).
B – The share of companies in the total number (%).

Thus, as shown by the analysis performed, zero and negative values of the K_{lk} indicator took place in those cases when:

- The enterprise did not use any of the considered mechanisms for joint activities with suppliers.
- Coordination mechanisms were used, but the effectiveness of their application was fully comparable (or lower) to the losses incurred as a result of such interaction.

In addition, the widespread fact is the total absence of both the effect and losses. For example, one of the participants of the research is an enterprise involved in the production and realization of finishing decorative materials that worked with suppliers for the past three years in the areas of participatory planning and resource integration (partners' personnel was involved in operations to carry out procurement). Neither positive nor negative results were obtained from such joint activities. As a result of the absence of the interaction effect, the K_{lk} indicator equalled zero.

Thus, the performed assessment of companies confirms the fact that the optimal use of coordination mechanisms is an individual characteristic. It also depends on the type of enterprise, the industry in which it operates, the strategy used and the potential for interaction between supply chain participants, the specifics of purchased and sold products, the stage of the life cycle in relations with suppliers, their quantity, style of relations with major and minor suppliers, probable risks of interaction, etc. As a result, the basic level is acceptable for one enterprise, while others seek strategic partnerships with suppliers. However, based on the analysis of only this parameter, it is difficult to get a complete idea of the level of logistical coordination of an enterprise with its suppliers.

For an objective assessment of the situation, it is necessary to understand the real benefits of enterprises from the implementation of partnerships with suppliers. In this regard, as part of the study, an analysis of parameter investment productivity was conducted, which illustrates the return on investment of financial and time resources of companies in the formation and development of partnerships with suppliers.

Table 4 shows the indicators included in this complex criterion, as well as the corresponding values and the final rating (according to the data provided by the experts). The highest values are typical for the companies of the first group, which showed the greatest return on investment, the minimum periods of implementation and payback from the use of joint activity mechanisms, and a sufficient return on investment in comparison with the cost of implementation. The indicators of enterprises in the second and third groups have mid-level and base values. The results of the enterprises of the fourth group indicate the absence of any investments and, accordingly, positive results of joint activities.

According to estimates provided by the experts from the enterprises participating in the study, there is a direct relationship between investment and the return on the use of coordination mechanisms. In cases where at the early stages of the formation of relations with suppliers, the effect of using certain coordination mechanisms was not calculated accurately enough, a situation is possible when investments are not entirely justified. Moreover, the risks of relations with suppliers can lead to increased costs (for example, a key supplier is an enterprise with a higher level of economic development. As a result, such a supplier often influences their partners, determining prices, terms of supply, payments, etc. to the detriment of other participants in the supply chain).

However, in most cases (especially if approximately equal partners interact), the analysis of the indicators shown in Table 4 allows one to form an objective idea of both the actual productivity of investments (depending on the level of use of coordination mechanisms) and the feasibility of promising investments.

As a result of a comprehensive analysis of enterprises according to the criteria under study (the level of use of coordination mechanisms and the productivity of investments in the development of joint activities with suppliers), a scale of ratings was built that allows one to conclude the actual effectiveness of the use of coordination mechanisms by enterprises in the process of interaction with suppliers (and, as a result, the readiness of companies from supply chains to form partnerships) Table 5.

Table 4.
Rating of enterprises by the criterion of investment productivity (According to the average data provided by experts of the companies participating in the study over the past three years, as of October 1, 2021).

Investment productivity indicators	Group of companies			
	I	II	III	IV
1. Share of expenses for the implementation of areas of joint activities with suppliers (In the total annual procurement budget, %)	5-7	3-5	2-3	0-0.1
2. Implementation time (Months)	3-4	5-12	12-18	Over 18
3. Return on investment (ROI, %)	7-12	3-7	1-3	0-1
4. Return on investment period (Months)	6-8	8-20	20-30	Over 30
5.Rating of productivity of investments in the development of partnerships with suppliers (P inv, points)	8-10	4-7	1-3	0-0.9

Table 5.
The grading scale for determining the level of logistics coordination in the procurement of enterprises from supply chains.

Coordination level	Main characteristics	Priority coordination mechanisms
High	• Partnerships with strategic suppliers, competitive strategy with base and contract suppliers; • The share of partners is about 20% of the total pool of suppliers; • High potential for joint development with key partners; • The share of joint projects is 30-35% in the volume of procurement activities; • The ratio of successful and unprofitable joint projects over the past 3 years is 90/10%; • The best dynamics in terms of the indicator of the share of the orders completed (Growth over the past 3 years: 30% for 75% of companies); • K_{lk}: From 10 to 20.5 pts; • P_{inw}: 8-10 pts;	• Strategic joint planning for a period of 3 to 5 years or more; • Harmonization of the partners' guidance documents; the use of these coordination mechanisms accounts for 70 to 100% of the total volume of joint work with suppliers; the effectiveness of the application is 9-10 pts; • Informational integration (More than 40% of the total volume of joint activities; efficiency is 7-8 pts); • Situational use of resource and motivational mechanisms;
Stable	• Interaction with strategic suppliers based on partial partnership (Cooperation but without joint development); competitive strategy with basic and contract suppliers; • The share of partners in the total number of suppliers is 8-10%; • The share of joint work of on average 23-25% in the volume of procurement activities; • The ratio of successful and unprofitable joint projects over the past 3 years is 50/10%; • The best dynamics in terms of the share of violations of supply obligations (A 30% decrease over the last 3 years for 40% of companies); • K_{lk} – 3.8-8.6 pts; • P_{inv} – 4-7 pts;	• Joint planning for 2-3 years (Ranges from 20 to 90% of the total amount of joint work; the effectiveness of the application is 9 pts); • Coordination of operating procedures (On average, about 24% of the total volume of joint work); the application effectiveness is 7 pts; • Information integration (On average 18-20% in the total volume of joint activities; efficiency 5-6 pts); • Partial resource integration (Material and labor resources);
Basic	• The share of key suppliers in relations with which elements of cooperation are used 3-4% in the total pool of suppliers; competitive strategy with others; • The share of joint projects in the volume of procurement activities is 12-15%; • The ratio of successful and unprofitable joint projects over the past 3 years is 45/25%; • The best dynamics in terms of the level of consistency of purchase and sales plans while increasing the level of dependence on suppliers; • K_{lk} – 0.8-2.4 pts; • P_{inw} – 1-3 pts;	• Coordination of operational procedures within 1 year (On average, 20-22% of the total volume of joint work with suppliers); • The effectiveness of the application is 3-4 pts; • Limited use of resource integration mechanisms; • Effectiveness 2-3 pts;

Coordination level	Main characteristics	Priority coordination mechanisms
Low	• Competitive supplier relationship strategy; • Low capacity for coordination, there is practically no joint activity with suppliers; • Insignificant positive dynamics in the indicators of the volume of purchases and costs of purchases; negative dynamics in terms of indicators of the average level of stocks and the share of violations of supply obligations; • Lack of investment in the development of partnerships • K_{lk} – 0; • P_{inv}: From 0 to 0.9 pts	• Fragmented application of the mechanism for coordinating operating activities with the underlying suppliers (For short periods of less than 1 year); • Efficiency: 1-2 pts

As it follows from the rating scale presented in Table 5, four levels of logistics coordination in the procurement activities of enterprises in the supply chain depending on the actual state of the considered criteria were identified.

Each of the rating scale levels characterizes the procurement activity of the research participants both in terms of the actual use of coordination mechanisms (and, accordingly, the degree of integration with suppliers), from the standpoint of qualitative criteria, such as the strategy used for the relationship of counterparties and the potential for interaction between the parties, and in terms of the productivity of investments in the process of establishing and developing partnerships and, thus, it partially correlates with well-known procurement concepts, namely, the models of Van Weele and Van Raaij [23], Klynveld Peat Marwick Goerdeler (KPMG), Monzka [24], the SRM system, etc.

In particular, the six levels of procurement maturity identified in the models by Van Weele and Van Raaij [23] and KPMG can be supplemented with copyright indicators (K_{lk}, P_{inv}.) reflecting the actual effectiveness of the use of coordination mechanisms. In this case:

- The operational level in these models corresponds to the position of low level of coordination in the proposed rating scale: competitive relationship strategy, low potential for joint development, the absence of partner suppliers, zero share of joint work, and lack of investment in the development of partnerships. The use of coordination mechanisms is minimal; mainly coordination of operational functions is used for short periods. However, the effectiveness of such joint work is extremely low;
- The commercial and coordination levels are consistent with the position of the basic rating scale. At this stage, companies implement separate joint projects with some of the basic suppliers, but only for solving operational problems and for short periods (under 1 year). In this regard, the most relevant coordination mechanism is the harmonization of operating procedures. At the tactical level, in the context of carrying out particular collaborative initiatives, fragmented mechanisms of resource integration (shared use of material and information resources) are being deployed;
- The level of internal and external integration in the proposed rating scale corresponds to the stable position. At this stage, enterprises have regular partner suppliers. Joint planning becomes sustainable with a focus on 3 years and fairly high efficiency; a mechanism for information integration with key suppliers is developing, a unified personnel motivation system begins to form, etc.

The level of integration of the value chain is correlated with the high position of the rating scale. Up to 90% of the total volume of procurement activities are spent in active cooperation with prospects for joint development with strategic and basic suppliers, and the share of joint projects (primarily in the area of joint strategic planning of demand and determining of needs, harmonisation of guidance documents in the field of process logistics management) occupy up to 90% of the total volume.

4. Conclusions

1. The results of calculations that are obtained for general and individual indicators for coordination level of mechanisms usage, along with an assessment of qualitative parameters and an analysis of the productivity of investments in the development of partnerships with suppliers, allowed us to perform a comprehensive study form a rating scale. We were able to conduct a thorough analysis and create a rating scale thanks to the summary results of the calculations for obtaining general and specific indicators of the level of coordination mechanisms use, as well as an evaluation of qualitative parameters and an analysis of the productivity of investments in the development of partnerships with suppliers. As a result, we identified four levels of logistics coordination in the procurement activities of companies. A conclusion was made about the degree of the actual effectiveness of the coordination mechanism used by enterprises in the process of their interaction with suppliers (and, as a result, about the readiness of supply chain companies to form partnerships).

2. The results of the analysis reveal that, according to the combination of the considered criteria, a high level of coordination is required for less than 10% of the surveyed companies. These include foreign manufacturing enterprises (automotive, food industry) operating in the Russian market. The main share of the surveyed companies is characterized by

stable and basic levels of procurement coordination. These are mainly Russian manufacturing, transport, and forwarding companies, warehouse operators, and wholesale and retail trade enterprises.

3. We concluded that the optimal level of logistics coordination is individual for each company and depends on the type of enterprise, the industry where it operates, the specifics of the procurement process, the phase of the life cycle, the style of relations with various categories of suppliers, probable losses from interaction, etc. As a result, the basic level is sufficient for a company, while others (having the appropriate prerequisites) strive for strategic partnerships with suppliers at the level of internal and, external integration.

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