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FORMATION OF MUTUAL RELATIONS BETWEEN ENTERPRISES AND BUSINESS PARTNERS IN THE PROCESS OF PREPARATION AND PRODUCTION OF NEW PRODUCTS

Abstract. *This article summarizes the scientific approaches to improving the quality of relations between the enterprise and business partners in preparation for the release and production of new products in today's economic realities. The study's main purpose is to substantiate and develop a methodological approach for determining effective relationship models between enterprises and business partners to prepare and produce new products. The article presents a developed four-stage methodological approach. The first stage of the study presents an analysis of existing approaches to forming relationships between the enterprise and business-business partners to prepare and produce new products. In the second stage, factual data on machine-building industry enterprises' functioning were collected to determine the effectiveness of cooperation and success, which are the key components that improve the quality of relations between the enterprise and business partners in preparing new products. At the third stage, partners' priority was determined to characterize the quality of the relationship between machine-building enterprises and business-business partners. The fourth stage determined the relationship between the qualitative levels of business partners' priority and appropriate relationship models to prepare and produce new products. The study used expert methods, multidimensional factor analysis, additive convolution method, structural-logical method, graphical method. A survey of enterprise representatives was conducted to assess the effectiveness of cooperation on 12 surveyed machine-building enterprises. Partial indicators were identified and substantiated by multidimensional factor analysis,*

generalized for making decisions about business partner enterprises' existing opportunities to prepare and produce new products. Based on the calculation of the integrated indicator, partners' priority was determined. That characterized the quality of relations between machine-building enterprises and business-business partners in preparing and producing new products. According to the Harrington scale specified for the economic conditions of Ukraine, the qualitative levels of partner companies' priority were determined. The proposed effective models of relationships for preparing and producing new products are put in line with them. The study results could improve the quality and validity of the formation and maintenance of relationships between enterprises and business partners in preparing and producing new products.

Keywords: new products, effectiveness, cooperation, success, functioning, business partner, relationship.

Introduction. The dynamic development of technology leads to the need to constantly improve existing products, develop and implement fundamentally new ones that will allow companies to create certain competitive advantages that will contribute to the constant growth of their competitiveness. At the same time, in the production of new products, companies are particularly active in cooperating with business partners, which directly affects their ability to manufacture high-quality, competitive, innovative products. That necessitates a critical analysis of approaches to forming the relationship between the enterprise and business partners in producing new products. Besides, that is especially true for machine-building enterprises. Therefore, it is important to identify existing approaches to the relationship between the company and business partners in preparation for the release of new products and their production. That is determined by the effectiveness of enterprises' cooperation and success and characterizes business partners' priority for the company. Thus, the proposed study aims to improve and further develop existing approaches in the scientific discourse on forming relationships between enterprises and business partners in preparation for the release and production of new products.

Literature Review. Collaboration is an inter-organizational relationship focused on technological innovation's joint development (Powell et al., 1996; Ahuja, 2000; Stewart, 2000). Such relationships use a common approach to innovation, which involves a combination of knowledge, technology, and other resources. Collaboration allows partners to take advantage of both an open innovation approach that uses new external resources (Chesbrough, 2003; O'Mahony and Ferraro, 2007) and a closed innovation approach that protects the ownership of contract-based innovation (Gans et al., 2002; Mayer and Argyres, 2004). Preliminary research gives some idea of the cooperation effectiveness in the field of technology. The emphasis is primarily on structural innovation. Research has shown that technology collaboration between organizations with powerful research and development capabilities and relevant complementary technologies could be highly effective (Hagedoorn, 1993; Ahuja, 2000; Stuart, 2000). Cooperation with effective management and business partners with extensive cooperation experience, based on the relationship of trust, could also be highly effective (Gulati, 1995; Uzzi, 1996; Anand and Khanna, 2000; Kale et al., 2002). Many collaborating organizations use intellectual property protection forms such as trade secrets (Katila et al., 2008) and achieve other results, such as new products (Katila, 2002). Alliance research showed that performance indicators (such as duration) were mainly used to address using different relationships (Doz, 1996). However, the relationship duration is a problematic indicator, as business partners often break off technological cooperation when their innovation goals were realized, i.e., enterprises succeed (Arino and De La Torre, 1998). A major challenge in managing technology collaboration is that partners have their own well-established innovation processes that could conflict (Davis and Eisenhardt, 2011). Also, partners will have different decision-making rules for research management, pursue clear product-market goals, and have people with very different levels of competencies (Allen, 1977; Clark, 1991; Brown and Eisenhardt, 1997). Reconciling these differences requires recombining business partners' aspects without overly restricting innovation to too large a structure (Davis et al., 2009). Relevant preconditions could be general. This coordination of the decision-making process, goals, and participants takes place mainly during joint work (Davis and Eisenhardt, 2011).

It suggests that the understanding of the process of forming a relationship between the company and business partners in preparation for the release and production of new products may be much smaller than it initially seemed.

Methodology and research methods. This study involved the scientific approaches to improve the quality of relations between enterprises and business partners in preparation for the release and production of new products to justify decisions on business partners' choices based on their priority. That was proposed to define in two aspects: effectiveness of cooperation and successful operation. The study is based on the generalization of existing scientific and theoretical approaches and studying the machine-building industry's actual data. For ensuring an integrated approach to the research, a four-stage methodological approach is proposed and used. The first stage of the study provided an analysis of existing approaches to forming the relationship between the enterprise and business partners in preparing for the release of new products. The second stage collected factual data on machine-building enterprises' functioning to determine the effectiveness of cooperation and success, i.e., the key factors that improve the quality of relations between the enterprise and business partners preparing for production and producing new products. At the third stage, the partners' priority was determined. It characterizes the quality of relations between machine-building enterprises and business partners in preparation for the release and production of new products. In the fourth stage, the relationship between partners' quality levels and appropriate models of relationships to produce new products were determined. For research, the authors selected 12 enterprises of the machine-building industry. These enterprises are representatives of their various subsectors. For each of them, an analysis was conducted on such aspects as the effectiveness of cooperation and the operation's success, which characterize the priority of cooperation with business partners. For providing the quality of relations between the enterprise and business partners in the process of preparing for production and producing new products to affect the results of cooperation positively, ensure their stability, efficiency, and integration, it is advisable to pay attention to the effectiveness of cooperation, namely efficiency, and consequence. They should deepen the manufacturer's key competencies, ensuring its strategic position in the market. This study involved expert methods. Thus, the questionnaire was developed and offered to experts (managers of enterprises) to assess the effectiveness of cooperation for 12 surveyed machine-building enterprises using a 5-point scale. Experts representing manufacturers by each characteristic corresponding to a certain component of the cooperation effectiveness rated the relevant partners with whom they come into contact in points from 0 to 5. Herewith, 5 corresponds to the assessment «excellent»; 0 – «unsatisfactory» or this characteristic is not inherent in the enterprise.

Using the assessments provided by experts on the characteristics of the cooperation effectiveness (CE) by the additive convolution method, an integrated indicator is calculated that takes into account the views of experts (managers) on the benefits of the relationship between enterprise and business partners in preparation for production and production of new products:

$$CE = \sum_{i=1}^{n} k_{signi} \frac{x_{acti}}{x_{refi}}, \qquad (1)$$

where n – the number of proposed characteristics of the components of the cooperation results for the qualitative component of the partners' evaluation; k_{signi} – coefficient of the significance of the i-th characteristics of the cooperation effectiveness for the qualitative component of the partners' evaluation; x_{acti} – the actual value of the i-th characteristics of the components of the cooperation effectiveness in the qualitative component of the partners' evaluation; x_{refi} – the reference value of the i-th characteristics of the components of the cooperation effectiveness in the qualitative component of the partners' evaluation, which is equal to 5 points.

The success of the relationship between the enterprise and business partners in preparation for the release and production of new products is ensured by the efficient use of economic resources and positive trends in innovation. Thus, only capable of developing enterprises could be priority business partners that form competencies to meet new products' demand. Data from 12 machine-building enterprises of the Kharkiv region were used to determine the general economic trends of machine-building enterprises (as partners that characterize the microeconomic level) and their internal environment (depends on the external environment). For identifying trends inherent in these enterprises in the success of functioning, it is advisable to use the data of official statistical reporting to calculate the indicators that characterize their activities. It is advisable to use multidimensional factor analysis to increase the reliability and update the resulting data,. Besides, it was carried out in two stages: 1) separately by resource and innovation. Thus, the first stage provided separation of the most important indicators to finalize the performance indicators system of machine-building enterprises in preparation for production and production of new products. The second stage was to combine the most significant indicators identified in each area and implement them into multidimensional factor analysis to finally clarify the composition of the indicators system of the enterprises functioning success. Partial indicators, defined and substantiated by multidimensional factor analysis, should be summarized for final decisions about partner companies' existing opportunities to prepare for and produce new products. That is is an important factor in determining the types of relationships and patterns of application. Many methods could carry out generalization. However, since all indicators characterize a holistic phenomenon (the success of functioning) and their significance could weigh them, such generalization should be carried out by additive coagulation, considering the standardization of significance factors (factor loads), multidimensional factor analysis, normalization of quantitative values of partial indicators. According to the formula of the integrated indicator using the method of additive convolution (to achieve methodological unity of the calculation of integrated indicators), the success of functioning was calculated by the actual quantitative values of indicators based on official statistics for the surveyed enterprises:

$$SF = \sum_{j=1}^{m} l_{signi} \frac{y_{acti}}{y_{refi}}, \tag{2}$$

where m – the number of partial indicators of the enterprise functioning success; l_{signi} – the significance coefficient of the j-th partial indicator of the enterprise functioning success; y_{acti} – the actual value of the j-th partial indicator of the enterprise functioning success; y_{refi} – reference value of the j-th partial indicator of the enterprise functioning success.

The integrated indicator's quantitative values were calculated to identify priority partners that could meet and ensure the necessary efficiency, consequent cooperation, and meet the producers' demand based on the efficient use of economic resources. The formula calculates the integrated indicator of the business partner priority in choosing the relationship with him manufacturers in the process of preparation for the release and production of new products:

$$BPP = V_{SF}xSF + V_{CE}xCE, \tag{3}$$

where VSF – the significance coefficient of the integrated indicator of the partner functioning success; SF – the integrated indicator of the partner functioning success; VCE – the significance coefficient of the integrated indicator of the cooperation effectiveness with the business partner in the process of preparation for the release and production of new products (according to the manufacturer); CE – an integrated indicator of the cooperation effectiveness in the process of preparation for the release and production of new products (according to the manufacturer).

The analysis of the relationship between the enterprise and business partners in the process of preparation for the release and production of new products used: multidimensional factor analysis – to

justify the system of the enterprise success indicators; additive convolution method - to determine the integrated indicators; structural-logical method – to substantiate the methodological approach and determine the relationship between the priority of the business partner and the model of the relationship with him of the manufacturer; method of expert evaluations - to determine the characteristics of the cooperation effectiveness in the process of preparation for the release and production of new products; graphic – to visualize the results.

Results. For determining the characteristics in the process of preparation for the release and production of new products on the proposed components of the cooperation effectiveness, which determine both the choice of partner and the type of relationship between the manufacturer and him, a questionnaire was developed. According to the questionnaire, experts were asked to name the characteristics of the efficiency components and consequences of cooperation. Thus, these data allowed characterizing it from the manufacturer's standpoint, which is impossible to determine based on official statistics. Besides, the respondents characterized interaction with business partners in qualitative terms, both objective and subjective ideas about the release of new products. According to the questionnaire, 12 experts were interviewed. They are the leading specialists and heads of innovation, logistics, and marketing departments of machine-building enterprises. The experts' selection was carried out following the activities analysis results to produce new products by the studied enterprises, which are closely related. The experts' quality was checked based on self-assessment of their professionalism, which was relatively high. Thus, it confirmed the quality of the experts' group. According to the questionnaire, the experts were asked to name the characteristics of the components of the effectiveness of cooperation in preparing a business partner for the production and producing new products, in qualitative terms, considering both practical objective knowledge and subjective perceptions of profitability. Table 1 presents the obtained survey results.

Table 1. Qualitative characteristics of the cooperation effectiveness of industrial enterprises with business partners

Component	Characteristics	% experts responses who noted the significance and importance of the characteristics,%
Effectiveness of cooperation	1. Profitability of conditions of production and service delivery.	88,97
	2. The advantage of the payment terms by term and form.	86,94
	3. Reducing the cost of concluding a contract.	96,87
	4. Flexibility of contract change conditions.	93,34
	5. Reliability of the relationship in the process of creating new products.	83,32
	6. Satisfaction with the terms of cooperation.	80,0
	7. Achievability of innovative goals.	85,63
Consequence of cooperation	8. Improving customer service of the enterprise when buying new products.	82,73
	9. Improving the quality of innovative products.	93,33
	10. Growth of image as innovators of the enterprise-manufacturer and the enterprise-partner.	89,02
	11. The growth of the manufacturer's brand value and the partner company in terms of innovation.	93,31

Sources: developed by the authors.

According to Table 1, the cooperation effectiveness in terms of new products is ensured by influencing the four characteristics. The first is the low level of costs for implementing the relationship, due to the cost of the entire cycle of activities for the production of new products, namely – the cost of negotiations, conclusion, and signing of supply contracts, innovation management, and production costs. The second is the flexibility of the terms of the contract for the supply. That provides the possibility of changing the terms of delivery by the number of payments, the form of payment, amount of funds, and certain risks. The third is the profitability of the terms of delivery of products from the partner, which means the terms of delivery time, batch size, location, number of deliveries, method of delivery, conditions, storage costs; conditions of after-sales maintenance, as the partner's products have production and technical purpose. The fourth is the profitability of payment terms for the supply of products affected by the term and payment form. That is the possibility of obtaining a deferral in the form of trade credit or subscription, receiving discounts on the number of goods, delivery time, number of deliveries.

The experts identified the component of the cooperation consequences according to seven characteristics, which are:

• improving product quality through the use of new materials, design solutions, functional expansion, and adaptation of products to new consumer needs; the implementation of additional values relevant to consumers;

• growth of the enterprise-manufacturer and the enterprise-partner brands' value on an innovative component that strengthens their strategic positions, allows to implement corporate and functional strategies, promotes the efficiency of use of strategic, competitive, production, and market potential of the enterprise;

• creating additional positive impressions of the image of the manufacturer, improving its image by informing suppliers as reliable partners, having domestic and international awards as the best manufacturers, well-known brands, well-established financial position, the market value of which is constantly growing;

• achieving the goals of cooperation, which allow to reduce the risks of production and procurement, diversify production or take the lead based on the concentration of production or development of innovative, new to the market, i.e., mutational products;

• satisfaction with the relationship, providing a partner with a high level of satisfying the manufacturer's needs. In turn, the satisfaction is to achieve a certain level of compliance with the expectations of the manufacturer, a positive result of cooperation compared to alternative supply options, achieving consumer satisfaction with the final products of the manufacturer, the prospects for the development of relationships, their personalization;

• improving customer service through the creation of service networks, the use of joint supply networks, which creates a synergy of procurement;

• interdependence of the manufacturer from the partner could be formed in the course of activity concerning the release of new products. Herewith, the interdependence means the reliability and profitability of the relationship, determined by such factors as technology (which consist in the use of joint production technologies, logistics technologies, the transfer of certain technological operations or functions to the supplier); organizational (which consist in participation in joint associations, unions, corporations, projects, signing of strategic partnership agreements); social (connecting buyers and sellers through personal contacts, the absence of conflict situations in the procurement process). Thus, interdependence is seen as a stimulant characteristic that contributes to the relationship's stability and profitability.

The list of characteristics for the cooperation effectiveness components was determined based on the expert ranking method provided the evaluation of significance. The consistency of the experts' opinions confirms the calculation of the concordance coefficient, which is 0.74. Therefore, it allows asserting the

non-randomness of the experts' answers, their significant consistency, and expediency of use in further research. The values of the significant coefficients of the characteristics and components of the enterprise's effectiveness of cooperation with the enterprises and business partners were calculated as the weighted average according to experts' answers (Table 2).

Table 2. Significance coefficients of characteristics and components of cooperation efficiency at the formation of mutual relations of the enterprises-manufacturers with business partners

Component	Characteristics	Significance coefficient of the characteristic
Effectiveness of cooperation	1. Profitability of terms of delivery of products for service.	0,0914
	2. Profitability of the terms of payment by term and form of payment.	0,0893
	3. Reducing the cost of concluding a contract.	0,0995
	4. Flexibility of contract change conditions	0,0959
	5. Reliability of the relationship in the process of creating new products.	0,0856
Consequence of cooperation	6. Satisfaction with the terms of cooperation.	0,0822
	7. Achievability of the set of innovative purposes.	0,0880
	8. Improving customer service of the enterprise when buying new products.	0,0850
	9. Improving the quality of innovative products.	0,0959
	10. Growth of image as innovators of the enterprise-manufacturer and the enterprise-partner.	0,0914
	11. The growth of the brands' value of the manufacturer and the partner company in terms of innovation	0,0959

Sources: developed by the authors.

According to the results of the evaluation (Table 2), the greatest influence on the component of the effectiveness of cooperation with business partners in terms of significance had the characteristic «Reduction of contract costs» (0.0995). That embodied the benefits of supply terms from the partner by delivery time, batch size, place, number of deliveries, delivery method, conditions, storage costs, conditions of after-sales maintenance, as the partner's products had production and technical purpose. According to the developed proposals, integrated evaluation indicators of the enterprise's cooperation effectiveness with business partners for the studied 12 machine-building enterprises were calculated. Table 3 shows the obtained values of the integrated indicators.

Table 3. Quantitative values of integrated indicators of the component of the manufacturers' cooperation effectiveness with business partners

Name of Company	The value of the integrated indicator
PJSC «Kharkiv Bearing Plant»	0,98092
JSC «Turboatom»	0,96422
PJSC Pivdenkabel Plant	0,81708
PJSC «Vovchansky Aggregate Plant»	0,81998
State Enterprise «Kharkiv Machine-Building Plant» FED»	0,83754
SE «Electrovazhmash Plant»	0,76306
PJSC «Electromachine»	0,761
PJSC Kharkiv Electrotechnical Plant Ukrelectromash	0,7809
PJSC «Plant. Frunze»	0,78308
PJSC «Kharkiv Tractor Plant»	0,61924

Continued Table 3

PJSC «Kharkiv Machine-Building Plant» Korum Svitlo Shakhtyar»	0,61924
Private JSC «Kharkiv Plant of Stamps and Molds»	0,65486

Sources: developed by the authors.

According to Table 3, the greatest quantitative value of the component of the cooperation effectiveness between enterprises and business partners, considering the subjective nature of the relationship, has estimates of the following partner companies: PJSC «Kharkiv Bearing Plant» (0.98092), OJSC Turboatom (0.96422), PJSC Pivdenkabel Plant (0.81708), PJSC Vovchansky Aggregate Plant (0.81998), the least - PJSC Kharkiv Machine-Building Plant Corum Svitlo Shakhtar (0.61924), Private JSC «Kharkiv Plant of Stamps and Molds» (0.65486). The developed methodological proposals were based on expert methods, appropriated for qualitative assessment of components that consider certain phenomena' subjective nature and are probabilistic. The methods of accurate quantitative calculations require the official use of statistical reporting. According to the proposed methodological approach, the study's next stage was to determine the enterprise's success. The method of factor analysis by the method of rotation Varimax raw allowed to obtain significant values of factors for the accumulated variance: for the resource direction, Figure 2 presents its value, Figure 3 – innovation. The analysis results showed that the four obtained factors described 78,68% variance of the entire primary list of factors for the resource direction (Figure 2) and 77.01% – for the analysis's innovative direction (Figure 4).

Factor Loadings (Varimax raw) (Spreadsheet32)
Extraction: Principal components
(Marked loadings are >,700000)

Variable	Factor 1	Factor 2	Factor 3	Factor 4
Var1	0,494233	0,302431	0,622337	-0,003096
Var2	0,537221	-0,042249	0,694419	-0,125106
Var3	-0,079936	0,056954	0,951253	0,048072
Var4	-0,035346	0,977600	0,032794	0,087919
Var5	-0,242989	0,319520	0,048754	0,763681
Var6	0,423186	0,317169	0,012812	0,633117
Var7	-0,042399	0,930495	0,045410	0,178731
Var8	-0,297929	0,656027	0,459141	-0,099018
Var9	0,909342	-0,067775	-0,027249	0,056494
Var10	0,953392	-0,071205	0,024759	-0,087108
NewVar1	0,708982	-0,097295	0,010921	0,301406
NewVar2	0,713731	-0,036232	-0,091407	0,058405
NewVar3	-0,035346	0,977600	0,032794	0,087919
NewVar4	-0,398441	-0,347958	0,311975	0,247257
NewVar5	0,953392	-0,071205	0,024759	-0,087108
NewVar6	-0,079936	0,056954	0,951253	0,048072
Expl.Var	4,692478	3,656610	3,004621	1,235297
Prp.Totl	0,293280	0,228538	0,187789	0,077206

Figure1. Factor load of indicators on the resource direction of the analysis
Sources: developed by the authors.

Eigenvalues (Spreadsheet32)
Extraction: Principal components

Value	Eigenvalue	% Total variance	Cumulative Eigenvalue	Cumulative %
1	4,769950	29,81219	4,76995	29,81219
2	4,094593	25,59121	8,86454	55,40339
3	2,645126	16,53204	11,50967	71,93543
4	1,079338	6,74586	12,58901	78,68129

Figure 2. The accumulated variance of factors by resource direction of analysis
Sources: developed by the authors.

Since 70% of the accumulated variance is sufficient for the reliability of the analysis results, the number of factors in both analysis directions is sufficient. Thus, it explains 78,68% of data variation by resource direction and 77.01% – by innovation.

Factor Loadings (Varimax raw) (Spreadsheet5)
Extraction: Principal components
(Marked loadings are >,700000)

Variable	Factor 1	Factor 2	Factor 3	Factor 4
Var1	0,446068	-0,095438	0,732067	-0,144104
Var2	-0,052394	0,122858	0,888727	0,114823
Var3	-0,047907	0,924930	0,068399	0,001909
Var4	-0,167192	0,608789	-0,123609	-0,036351
Var5	0,589279	0,513771	-0,139842	0,094362
Var6	-0,000128	0,928015	0,039331	0,107607
Var7	-0,302379	0,623702	0,528878	0,111609
Var8	0,897013	-0,075014	0,016419	-0,205202
Var9	0,899142	-0,134452	0,122111	-0,203684
Var10	0,777474	-0,008538	-0,016670	-0,084839
NewVar1	0,505743	-0,009769	-0,013498	-0,778119
NewVar2	-0,073680	0,094580	0,043304	0,930252
Expl.Var	3,149411	2,797315	1,664047	1,629846
Prp.Totl	0,262451	0,233110	0,138671	0,135820

Figure 3. Factor load of indicators on the innovative direction of the analysis
Sources: developed by the authors.

Eigenvalues (Spreadsheet5)
Extraction: Principal components

Value	Eigenvalue	% Total variance	Cumulative Eigenvalue	Cumulative %
1	3,777104	31,47587	3,777104	31,47587
2	2,751276	22,92730	6,528380	54,40317
3	1,575022	13,12518	8,103402	67,52835
4	1,137217	9,47681	9,240619	77,00516

Figure 4. The accumulated variance of factors in the innovative direction of analysis
Sources: developed by the authors.

Thus, the indicators selected by factor loads at the first stage of factor analysis should be selected and combined into a system that would reliably explain the existing trends in machine-building enterprises' success and could be used for further refinement and selective selection of its composition. Table 4 shows the system of indicators.

Table 4. System of indicators of functioning success of the machine-building enterprises on resource and innovative directions

Indicator name Indicator code	Indicator code
Resource direction	
Financial resources	
Coefficient of financial autonomy	R1
Profitability of sales	R2
Solvency ratio	R3
Liquidity ratio	R4
Coefficient of financial stability	R5
Material resources	
Fixed assets renewal rate	R6
Return on assets	R7
Capital adequacy	R8
Material efficiency	R9
Information resources	
The share of investments in informatization to the total investment	R10

	Countinued Table 4
The share of costs for participation in exhibitions and other image events in the total cost of sales	R11
The share of investment in software in the total investment in informatization	R12
Innovative direction	
Indicators of innovation activity	
The share of employees performing scientific and technical work	I1
The share of current costs of technological innovation in the total cost of innovation	I2
The share of long-term investment in technological innovation in the total cost of innovation	I3
The share of spending on research and development in the total cost of innovation	I4
The share of costs for technological preparation of production in the total cost of innovation	I5
The share of expenditures on machinery, equipment, tools, other fixed assets, and capital expenditures related to the implementation of innovations in the total expenditures on innovations	I6
The share of marketing and advertising costs in the total cost of innovation	I7
The share of innovative products in the total volume shipped	I8
The share of shipped products produced with significant technological changes or re-introduced within three years in the total volume of shipped products	I9

Sources: developed by the authors.

The application of multidimensional factor analysis using a selected system of indicators in both directions by rotation Varimax raw type allowed selecting factors whose characteristics are shown in Figure 5.

Factor Loadings (Varimax raw) (Spreadsheet13)
Extraction: Principal components
(Marked loadings are >.700000)

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Var1	0,260659	-0,319184	0,760942	0,279535	0,160538
Var2	0,311169	0,043072	0,841669	0,225228	0,174440
Var3	-0,107543	-0,039080	0,872720	-0,200362	-0,161779
Var4	-0,067340	-0,969438	0,029963	-0,023884	0,013284
Var5	-0,027051	-0,973408	0,036334	-0,095751	-0,078591
Var6	0,860340	0,043139	0,095125	0,016266	0,303551
Var7	0,887870	0,069198	0,162539	0,047920	0,284922
Var8	0,844377	0,024681	0,021003	0,158422	-0,012019
Var9	0,455668	0,028814	0,038444	-0,013740	0,852104
Var10	0,181927	0,061085	0,042312	0,909377	0,064943
NewVar1	0,015943	0,169235	0,063862	0,902452	0,067717
NewVar2	0,311169	0,043072	0,841669	0,225228	0,174440
NewVar3	-0,107543	-0,039080	0,872720	-0,200362	-0,161779
NewVar4	-0,067340	-0,969438	0,029963	-0,023884	0,013284
NewVar5	0,497550	-0,460574	0,037109	0,088249	-0,051962
NewVar6	-0,027051	-0,973408	0,036334	-0,095751	-0,078591
NewVar7	0,860340	0,043139	0,095125	0,016266	0,303551
NewVar8	0,887870	0,069198	0,162539	0,047920	0,284922
NewVar9	0,844377	0,024681	0,021003	0,158422	-0,012019
NewVar10	0,455668	0,028814	0,038444	-0,013740	0,852104
NewVar11	-0,024899	-0,101535	0,024787	-0,269716	-0,818485
Expl.Var	5,474993	4,154299	3,606196	2,056979	2,632204
Prp.Totl	0,260714	0,197824	0,171724	0,097951	0,125343

Figure 5. Factor load of indicators on resource and innovative directions of the analysis
Sources: developed by the authors.

A sufficient number of factors is 5, which is due to the value of the accumulated variance – 85.36% (Figure 6).

Eigenvalues (Spreadsheet13)
Extraction: Principal components

Value	Eigenvalue	% Total variance	Cumulative Eigenvalue	Cumulative %
1	7,123588	33,92185	7,12359	33,92185
2	4,365749	20,78928	11,48934	54,71113
3	3,078658	14,66028	14,56800	69,37141
4	1,803734	8,58921	16,37173	77,96062
5	1,552940	7,39495	17,92467	85,35557

Figure 6. The accumulated dispersion of factors by resource and innovation directions of analysis
Sources: developed by the authors.

The value of factor loads of indicators for each factor (Figure 5) proved the feasibility of using partial indicators to assess the enterprise's success functioning; the factor loads greater than 0.7. Thus, the impact of which on its production of new products is significant.

Based on factor loads, the following partial indicators were identified: financial autonomy ratio (R1), sales profitability ratio (R2), solvency ratio (R3), liquidity ratio (R4), financial stability ratio (R5), fixed assets renewal rate (R6), return on assets (R7), capital adequacy (R8), material efficiency (R9), share of investments in informatization to total volume of investments (R10), share of expenses for participation in exhibitions and other image events in the total expenses for sales of products (R11), share of investments in software in the total amount of investments for informatization (R12); the share of employees performing scientific and technical work (I1), share of current expenditures on technological innovations in total expenditures on innovations (I2), share of research and development expenditures in total expenditures on innovations (I4) , the share of costs for technological preparation of production in the total cost of innovation (I5), the share of costs for machinery, equipment, tools, other fixed assets and capital costs associated with the implementation of innovations in the total cost of innovation (I6), the share of marketing and advertising costs in the total cost of innovation (I7), the share of innovative products in the total shipped (I8). According to the formula of the integrated indicator of the enterprise functioning success, its actual quantitative values for the studied enterprises were calculated (Table 5).

Table 5. Quantitative values of integrated indicators of activity machine-building enterprises of Kharkiv region for 2015–2019

Name of Company	2015	2016	2017	2018	2019
PJSC «Kharkiv Bearing Plant»	0,385	0,419	0,382	0,429	0,417
JSC «Turboatom»	0,332	0,327	0,347	0,330	0,326
PJSC Pivdenkabel Plant	0,315	0,302	0,295	0,304	0,289
PJSC «Vovchansky Aggregate Plant»	0,346	0,354	0,342	0,348	0,327
State Enterprise «Kharkiv Machine-Building Plant» FED»	0,315	0,328	0,331	0,328	0,335
SE «Electrovazhmash Plant»	0,298	0,262	0,305	0,284	0,296
PJSC «Electromachine»	0,265	0,277	0,267	0,255	0,257
PJSC Kharkiv Electrotechnical Plant Ukrelectromash	0,271	0,262	0,249	0,245	0,249
PJSC «Plant. Frunze»	0,232	0,255	0,216	0,220	0,249
PJSC «Kharkiv Tractor Plant»	0,251	0,209	0,223	0,276	0,253
PJSC «Kharkiv Machine-Building Plant» Korum Svitlo Shakhtyar»	0,262	0,250	0,282	0,239	0,224
Private JSC «Kharkiv Plant of Stamps and Molds»	0,251	0,258	0,252	0,250	0,215

Sources: developed by the authors.

According to Table 5, the best success of the functioning enterprise is PJSC «Kharkiv Bearing Plant», PJSC «Turboatom», PJSC «Vovchansky Aggregate Plant», the worst – Private JSC «Kharkiv Plant of Stamps and Molds», PJSC «Plant named after Frunze».

According to the calculated values of integrated indicators (Table 5), the functioning enterprises' success is not significant, as their maximum values should be close to one. The obtained low quantitative values of integrated indicators are explained by the objective economic situation at the enterprises. Subjective and objective components of the relationship between the enterprise and business partners in preparation for the release and production of new products, which was manifested in the objective quantitative results of management of the use of economic resources by the supplier and subjective qualitative ideas of the manufacturer the cooperation effectiveness in the process of preparation for the release of new products are unequal to determine the type of relationship, strategic alternatives and information tools for their formation and management. It is advisable to take into account quantitatively in

the overall integrated indicator, which could be calculated by additive convolution, taking into account the coefficients of its components significance, namely – the success and effectiveness of cooperation, because these components and factors interact with new products.

The expert survey method was used to quantify the significance of the objective and subjective components to calculate the partner priority's generalized integral indicator. As experts, 2 representative groups of specialists from among the representatives of enterprises and their partners were interviewed. Thus, it allowed determining the coefficients of significance. The concordance coefficient is W = 0.36, which indicates a weak but sufficient degree of agreement between experts' opinions. For assessing the significance of the concordance coefficient, the Pearson agreement criterion was calculated: x^2 = 19.85. The calculated x^2 compared to the tabular value for the number of degrees of freedom K = n-1 = 6-1 = 5 and at a given level of significance α = 0.05 is much larger than the tabular (estimated 19.85; tabular 11.07050). The value W = 0.36 is significant and not accidental. Therefore, the results obtained make sense and could be used in research. In turn, the experts agreed and suggested the possibility of using the significant coefficients of the objective (0.606) and subjective (0.394) components for enterprises and their business partners to calculate a generalized integrated indicator of partner priority. Therefore, to identify the preferred business partners that could meet the required effectiveness of cooperation and meet the demand of economic entities based on the efficient use of economic resources, the generalized integrated indicator's quantitative values characterized the business partner's priority. According to the generalized integrated indicator's calculated value, it was possible to rank the potential business partners' whole set. Table 6 presents the results of the analysis.

Table 6. The value of integrated indicators of the quality of the relationship between the enterprise and business partners in preparation for the release and production of new products (2019)

Name of Company	Integral indicators		Generalized integrated indicator of business partner priority	Company rating
	effectiveness of cooperation	successful functioning		
PJSC «Kharkiv Bearing Plant»	0,98092	0,417	0,639184	1
JSC «Turboatom»	0,96422	0,326	0,577459	2
PJSC Pivdenkabel Plant	0,81708	0,289	0,497064	5
PJSC «Vovchansky Aggregate Plant»	0,81998	0,327	0,521234	4
State Enterprise «Kharkiv Machine-Building Plant» FED»	0,83754	0,335	0,533001	3
SE «Electrovazhmash Plant»	0,76306	0,296	0,480022	6
PJSC «Electromachine»	0,761	0,257	0,455576	9
PJSC Kharkiv Electrotechnical Plant Ukrelectromash	0,7809	0,249	0,458569	8
PJSC «Plant. Frunze»	0,78308	0,249	0,459428	7
PJSC «Kharkiv Tractor Plant»	0,61924	0,253	0,397299	10
PJSC «Kharkiv Machine-Building Plant» Korum Svitlo Shakhtyar»	0,61924	0,224	0,379725	12
PJSC «Kharkiv Plant of Stamps and Molds»	0,65486	0,215	0,388305	11

Sources: developed by the authors.

Based on the results presented in Table 6, it is possible to assess business partners' priority for individual components and general for a generalized integrated indicator of priority, which characterizes

business partners' competence to produce new products. PJSC «Kharkiv Bearing Plant» has the best
rating, and PJSC «Kharkiv Machine-Building Plant «Korum Svitlo Shakhtar» has the worst rating.

For making sound management decisions on cooperation with business partners for the preparation
and production of new products by quantitative values of the generalized integrated indicator of priority of
business partners, it is also necessary to provide these quantitative values with qualitative interpretation.
For each of them, it is possible to form recommendations on using the most effective models of
relationships. For this purpose, it is advisable to use the Harrington scale adapted to the conditions of
management in Ukraine, which was developed for machine-building enterprises by Iastremska (2006) and
uses the provisions of fuzzy set theory on constructed membership functions that characterize the
boundaries of clear and fuzzy intervals: from 0 to 0, 19 – low level, from 0.19 to 0.30 – medium or low,
from 0.30 to 0.37 – medium, from 0.37 to 0.56 – high or medium and from 0.56 to 1.0 – high level. Since
the practical use of fuzzy intervals makes it difficult to make management decisions about partner priorities
and use relationship models, it is possible to move to clear intervals «low», «medium», «high» by
distributing fuzzy intervals at the level of segments according to the standard distribution membership
functions. Thus, the boundaries of clear intervals of quality levels of the generalized integrated indicator
of priority of partners for cooperation in the preparation and production of new products are as follows: low
– (0.0 - 0.245), medium – (0.245 - 0.455), high – (0.455 – 1.0). Based on the presented limits of clear
intervals of the generalized integrated indicator, the investigated enterprises in 2019 will be distributed as
follows: low level – 0; average level – 25%; high level – 75%.

This division of enterprises confirms the need to use effective models of enterprise relations with
business partners effectively. Features of model types of the interrelation of manufacturer enterprise with
the enterprises-business partners consist of generalization and development of the existing models offered
by Kulikov and Sihaieva (2009). Considering the peculiarities of new products, which are inherent in the
products of industrial and technical purposes of the machine-building industry, the types of existing models
in their essence and content concerning partnerships were proposed to distribute them by quality priority
levels of partner companies. Using the following classification features: the competence of persons who
make decisions on the formation of partnerships, the time of obtaining the result from the partnership, the
conditions for obtaining the effect, the purpose of cooperation. Thus, Table 7 presents the recommended
effective relationship models for preparing and producing new products under the qualitative levels of
partner companies' priority.

**Table 7. Types of models of relationships for the preparation and production of new products
with business partners following the qualitative levels of their priority**

Classification feature of models of the enterprises' priority relations business partners	Types of relationship models according to the qualitative levels of partners priority		
	low	medium	high
competence of persons who make decisions on the formation of partnerships	Decisions on cooperation with the use of intermediaries as guarantors of the professionalism of partner companies	Decision on cooperation on the recommendations of reference groups that cooperated with business partners	Independent decision on cooperation based on own experience
the term of the partnership	The short-term expectation of benefits from the relationship for the production of new products	The medium-term expectation of benefits from the relationship for the production of new products	The long-term expectation of benefits from the relationship for

Countinued Table 7

			the production of new products
conditions for obtaining the effect	Fairway to the production of innovative products that are new to the company and could form a short-term effect	Forward, that is mutational, for the production of innovative products that are new to the market and able to form a multiplier market effect	Lobbying for the introduction of innovations and production of new products, lobbying public, capable of creating sustainable effects for the quality development of society and filling the state budget
the purpose of cooperation	Gaining benefits from the effectiveness of cooperation	Gaining benefits from the success of the functioning	Gaining benefits from both the effectiveness of cooperation and the success of functioning

Sources: developed by the authors.

The use of the proposed models of relationships with business partners in the production of new products would competently select partners and form a relationship with them that will meet the interests of manufacturers and business partners, considering their ability to use all economic resources, opportunities implementation of innovative activities, the success of cooperation following the priority of functioning.

Conclusions. Business partners are competent for successful functioning, as they have the necessary economic resources to prepare for the release of new products. Besides, partners are competent to respond to consumer needs changes, as they track new developments and produce innovative products and invest appropriate resources in this process. Partners are also competent in terms of the cooperation effectiveness they could provide. The manufacturer could analyze many business partner companies based on their ranking by priority level to evaluate all entities' relative assessment, determining their relative competence. The proposed models of relationships with business partners in the process of preparation and production of new products are the basis for competent selection of business partners and the formation of such relationships with them that will meet the interests of manufacturers and business partners, taking into account their ability to use all economic resources, opportunities for innovation, the success of cooperation following the priority of operation.

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Формування взаємовідносин між підприємствами та бізнес-партнерами в процесі підготовки та виробництва нової продукції

У статті узагальнено наукові підходи щодо покращення якості взаємовідносин між підприємством та бізнес-партнерами при підготовці та виробництві нової продукції за сучасних економічних умов. Основною метою дослідження є обґрунтування та розроблення методологічного підходу до визначення дієвих моделей взаємовідносин між підприємством та бізнес-партнерами у процесі підготовки та виробництва нової продукції. Для досягнення поставленої мети, дослідження проведено у наступній логічній послідовності. На першому етапі проаналізовано наявні підходи щодо формування взаємовідносин між підприємством та бізнес-партнерами при виробництві нової продукції. На другому етапі здійснено збір фактичних даних щодо функціонування підприємств машинобудівної промисловості. Таким чином, це дозволило оцінити результативність

співпраці та якість взаємовідносин між підприємством та бізнес-партнерами в процесі підготовки та виробництва нової продукції. На третьому етапі встановлено пріоритети бізнес-партнерів. На четвертому етапі дослідження визначено взаємозв'язок між якісними рівнями пріоритетності бізнес-партнерів та доцільними моделями взаємовідносин в процесі підготовки та виробництва нової продукції. Емпіричне дослідження проведено з використанням інструментарію багатовимірного факторного аналізу, методів експертних оцінок та адитивної згортки, графічного та структурно-логічного методів. У ході дослідження проведено анкетування представників 12 машинобудівних підприємств з метою оцінки результативності співпраці. За результатами багатовимірного факторного аналізу виявлено та обґрунтовано часткові показники, які було узагальнено для прийняття рішень щодо можливої співпраці із бізнес-партнерами при підготовці та виробництві нової продукції. На основі розрахунку інтегрального показника встановлено пріоритети бізнес-партнерів та визначено якість їх взаємовідносин із машинобудівними підприємствами. При цьому авторами застосовано уточнену для економічних умов України шкалу Харінгтона для визначення якісного рівня пріоритетності підприємств-партнерів. За результатами запропоновано дієві моделі взаємовідносин для підготовки та виробництва нової продукції. Результати проведеного дослідження можуть бути корисними для покращення якості, формування та підтримки взаємовідносин між підприємствами та бізнес-партнерами при підготовці та виробництві нової продукції.

Ключові слова: нові продукти, ефективність, співпраця, успіх, функціонування, діловий партнер, відносини.