Evaluating the strategic directions of innovative development of the shipbuilding industry in Latvia

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Abstract

The shipbuilding industry in Latvia – the construction, repair and maintenance of ships and boats – plays an important role in the country's economy. In the context of globalization, there is quite tough competition for orders and sales markets among shipbuilding companies of the world at the regional and global levels. Goal of the research – the analysis of the condition of the Latvian shipbuilding industry and the evaluation of main strategic directions of its innovative development. The research has allowed identifying the most important directions of innovative development of the shipbuilding and ship repair industry. It has been found that at present the most topical directions of innovations in the shipbuilding industry are the development of workers' skills and improvement of the marketing system. There is an urgent need for the construction of new production facilities and repair of the existing ones. These main directions of innovations meet the first priority requirements of the industry and are necessary to improve its competitiveness. Without progress in the first three main directions of innovations, the successful development of the industry in all other directions is not possible.

Keywords:

shipbuilding industry
innovative development
competitiveness

1 Introduction

The shipbuilding industry in Latvia – the construction, repair and maintenance of ships and boats – plays an important role in the country's economy and has deep historical roots. The number of companies in the industry accounts for several dozen; mostly they are small and medium-sized enterprises. There are only two relatively large shipbuilding factories on a scale of Latvia: Riga Shipyard and Liepaja Tosmare Shipyard. The number of workers in the industry reaches 7–8 thousand people in the seasonal periods (in the spring and summer). At present, national and international regulatory organisations, marine registers and other agencies impose increasing demands on the quality of shipbuilding products. The requirements for environmental protection, crew qualification and navigational safety are considerably increased. This should be taken into account when companies of the industry execute the orders. To maintain successful performance in contemporary business conditions, shipbuilding companies both in Latvia and abroad should constantly improve their products and increase their quality. This implies the introduction of advanced materials for ships, manufacturing and repair technologies, computer hardware, modern designs, etc.

2 Subject and relevance

In the context of globalization, there is quite tough competition for orders and sales markets among shipbuilding companies of the world at the regional and global levels [1]. Competition takes many forms: it may be subject, functional; price, non-price and integral ways of competition are used. Often there are cases of illegal unfair competition; control methods are applied that violate generally accepted standards: poaching highly qualified specialists, posing artificial obstacles in obtaining credit, and others.

Global experience shows that the successful and rapid economic development of developing countries, to which Latvia can be attributed, took place when the country and its economic sectors, respectively, managed to find their own original solutions to overcome the backwardness and to increase competitiveness [2]. The experience has demonstrated that good progress is achieved by countries that use development models based on the perfect human capital and innovations [3, 4]. Countries by all means contributed to such a development. The main conditions for innovation and investment development of economic sectors in any country are: a high level of development of science and technology; a large proportion (up to 7%) of budget allocated to research and development (R & D); innovation projects on a global scale with the state support; a favourable legal framework and the availability of funds as the financial basis of innovation. Scientific and technological progress is introduced into production in the form of innovations [5]. Without the participation of highly qualified specialists, the introduction of innovations is impossible [6].

Unfortunately, Latvia occupies one of the last places in the EU by research and innovation: the number of innovative companies is insufficient, only slightly above 20%. In the EU, on average the innovative companies and industries account for more than 50%. According to the World Bank, the most successful companies in terms of innovations are medium and large enterprises that employ more than 250 people. Small enterprises that make up a large part of the companies of the shipbuilding industry in Latvia are less successful in the area of innovations. Lack of financial resources for introducing innovations is the main reason for a low innovation activity. In Latvia, there is also an acute shortage of qualified specialists in shipbuilding, ship repair, and in other sectors of the economy. The current low level of salary of majority of people employed in Latvia and a large income gap between the rich and the majority of population at relatively high prices for goods of daily consumption force most of the able-bodied young people and professionals to leave the country and go abroad to work [7].

The authors believe that the mission of the shipbuilding and ship repair industry in Latvia is as follows. The shipbuilding industry should be based on knowledge, information, and become one of the key leaders in the transition of Latvia to post-industrial, knowledge-based economy; it should take a worthy niche market in the Baltic Sea region, in a qualitative manner meet the needs of customers on a global scale and ensure the welfare of all workers in the sector. The choice of competitive strategies of the industry, i.e., a system of actions of its constituent companies, is made depending on the role and informative functions of these companies. Depending on the role function, major companies in the shipbuilding industry can be attributed to the “candidates for leadership”. They occupy about 30% of market share in their niche of the Baltic Sea region and seek to take a monopolistic position. In accordance with the informative function, the main companies in the industry can be attributed to the “patients” that specialize in certain niche markets. For example, recently in Latvia the company has been founded operating in the construction of yachts of medium size for relatively wealthy clients.

The originality of the research lies in the fact that the strategic directions of innovative development of the Latvian shipbuilding industry have been estimated for the first time, aimed at increasing its competitiveness for successful operation of the industry in the context of globalization. Object of the research is the shipbuilding and ship repair industry in Latvia. Goal of the research – the analysis of the condition of the Latvian shipbuilding industry and the evaluation of main strategic directions of its innovative development. Methods of the research are the analysis of statistical data and the expert estimation method based on traditional methods of computation and application of the fuzzy set theory.

3 Computation and analysis

The total number of companies involved in the construction, repair and maintenance of vessels in Latvia has been increasing steadily since the beginning of the 21st century [8]. For example, from 2005 to 2011, it increased by more than 1.5 times – up to 33. Although the number of permanent workers in the industry declined, sales volumes increased by more than 2 times – up to 81.5 million € from 2000 to 2012. The highest rate of sales was achieved before the crisis in 2008. Then, during the crisis period from 2009 to 2011 sales volumes significantly dropped by more than 2 times. Since 2012, there has been a steady increase in sales of shipbuilding and ship repair products. The downside is the fact that there is a decrease observed in the investment in real assets of the companies within the industry for the repair and maintenance of vessels. The decline was strongly affected by the crisis of 2008–2010: investment fell by almost 3 times. If we analyse the performance of small and medium-sized enterprises operating in the construction of sports boats and small boats for recreation, it can be said that the volume of their production greatly changed in the period of 2005–2011 due to the financial and economic crisis. In 2010 compared to 2007 they decreased by more than 3 times. This indicates that the industry is largely dependent on demand fluctuations in the world markets, since most of the production is exported. In general, it can be concluded that the analysis of statistics shows that the number of workers in the shipbuilding industry and the volume of sales are closely correlated with the respective indicators of the Latvian economy as a whole (the calculated correlation coefficients are 0.766 and 0.638, respectively). The industry and the national economy are integrated into the global economy; products are mainly exported.

The Latvian shipbuilding industry faces the same problems as other sectors of the national economy. Apart from the need to develop and improve human capital, and increase the number of highly qualified professionals in the industry, in order to enhance competitiveness it is necessary to develop innovations also in other areas: to introduce new modern ship designs and mechanisms, materials, construction and repair technologies, etc. This requires investment in fixed assets of enterprises: the acquisition and development of new equipment, machine tools, overhaul maintenance and construction of new production facilities, etc. At the same time, it is necessary to improve the marketing system of companies in the industry as well as finding sales markets. It is necessary to carry out an active search for commissioning clients all over the world, taking into account the global nature of competition in the shipbuilding and ship repair industry.

The need for innovative development of the Latvian shipbuilding industry is recognised by all the leading experts of the industry. However, as the survey has shown there is a great divergence of views on strategic priorities of innovative development. Taking into account limited financial resources of companies in the industry and the virtual absence of assistance from government agencies, for successful functioning in the context of global competition it is necessary to establish a unified development policy of innovative directions of the Latvian shipbuilding industry. This will help to coordinate the cooperation among the companies within the industry in terms of innovations, to apply the Japanese experience of cooperation, to establish constructive cooperation with state institutions in providing practical assistance to companies within the industry. Training and educating specialists for the industry at the public educational institutions can serve as an example.

There are many theories of decision making, starting with the well-known theory of Neumann and Morgenstern based on the construction and use of utility functions [9]. However, this theory is often not confirmed in practice [10, 11]. Therefore, it has not been used within the present research. Taking into account the wide divergence in expert opinions on the priorities in the directions of innovative development of companies within the shipbuilding and ship repair industry as well as vagueness of the information field, the expert estimation method has been used to perform the analysis and formulate recommendations in the research. This reduces the risk of making wrong decisions. By the expert estimation method, the group of competent experts measures the characteristics of the studied phenomena to develop optimal recommendations. The expert group included the principal specialists of the leading companies within the industry and professors at the Latvian universities (RTU, BSA); a total of 12 experts. As a result of the survey, six main directions of innovative development of the companies within the industry have been identified (Table 1). Each expert was asked to assess the directions of innovative development taking into account the greatest possible number of factors: the availability of funding, government assistance, economic viability, social implications, ecology and others. Experts rated the directions of innovative development using a universal quantification scale [1, 10]: 1 – the worst ranking (the lowest priority), 10 – the best ranking (the highest priority). The results of the survey of experts are presented in Table 1. The survey was carried out anonymously; experts answered the questions without consulting each other to eliminate the mutual influence on the results.

TABLE 1 The results of the survey of experts

Designation	Directions of innovative development	Expert estimates											
		1	2	3	4	5	6	7	8	9	10	11	12
A	Construction of vessels of new designs: for the transport of live fish, catamarans, etc.	7	4	6	10	6	10	5	6	6	5	9	6
B	The introduction of advanced materials and technologies	8	6	5	8.5	7	9	7	5	5	6	8	5
C	Development of workers' skills	10	10	9	10	10	10	10	9	10	10	9	10
D	Improving the marketing system	9	9	7	8	8	9	9	10	7	8	9.5	9
E	The construction of new production facilities and repair of the existing ones	6	5	8	8	4	10	8	7	8	8	7	8
F	The introduction of modern equipment and machinery	5	8	4	10	9	8	6	4	4	9	8	7

Estimates obtained as a result of the survey of experts demonstrate sufficiently large differences in their opinions. Thus, the problem arises to generate consolidated findings and recommendations in the face of uncertainty. The probability theory is not consistent with subjective categories of human thinking, and in this situation it does not suit. The fuzzy set theory allows evaluating the fuzzy concepts and information, carrying out the relevant calculations and making valid conclusions [12]. The success of its application is based on the Fuzzy Approximation Theorem proved in 1993 that states that any system can be approximated based on fuzzy logic. Fuzzy logic is much closer to human thinking than traditional logic. This allows successfully using it in management to make grounded decisions.

Within the research, the authors have carried out the multi-criterion estimation and analysis of alternatives for the case, when criterion estimation is determined as a degree of confirmity of alternatives to the concepts defined by criteria. The convolution operation has been used on the basis of fuzzy set intersection [13]. If there a set of m alternatives $(\alpha_1,\ \alpha_2,\ ...\ \alpha_m)$, a fuzzy set can be considered for criterion C [14]:

$$\tilde{C} = \sum_{i=1}^{m} \frac{\mu_c(\alpha_i)}{\alpha_i}, \tag{1}$$

where $\mu_c(\alpha_i) \in [0,1]$ – the estimation of alternative α_i by criterion C, which describes the degree of confirmity of an alternative to the concept defined by the criterion; i=1, 2, …12; $\sum$ is the sum of pairs $\mu_c(\alpha_i)$ and α_i.

From n criteria, it is assumed that the best alternative is the one that satisfies all the criteria $C_1, C_2,\ \dots C_n$. The rule for choosing the best alternative is written as the intersection of the corresponding fuzzy sets:

$$D = C_1 \cap C_2 \cap\ \dots \cap C_n. \tag{2}$$

The given operation of the intersection of fuzzy sets corresponds to the minimization operation applied to their membership functions:

$$\mu_D(\alpha_j) = min \mu_{ci}(\alpha_j), i = \overline{1,n}; \quad j = \overline{1,m}. \tag{3}$$

The best alternative is assumed to be α^*, which has the maximum value of the membership function [15, 16]:

$$\mu_D(\alpha^*) = max \mu_D(\alpha_j), j = \overline{1,m}?. \tag{4}$$

The construction of membership functions of fuzzy sets has been performed by the method of paired comparisons based on the processing of estimator matrices that reflect expert opinion on the expressiveness of a set element property formalised by this set [17, 18]. A special scale has been used to determine matrices of estimates with qualitative assessments of importance from "1" (equal importance) to "9" (extreme importance). Let the set of n elements be X = {x}. Let us assume that the estimate of element x_i compared to element x_j in terms of property S is α_{ij}. For concordance, it is assumed that $\alpha_{ij} = 1/\alpha_{ji}$. Estimates α_{ij} form matrix A = || α_{ij} ||. Solving equation Aw = λw, where λ – the eigenvalue of matrix A, we find the eigenvector of matrix A: $W = (w_1,\ w_2,\ ...\ w_n)$. The calculated values of w_i, forming eigenvector w, are taken to be a degree of confirmity of elements x to set S:

$$\mu_s(x_i) = \omega_i, \qquad i = \overline{1,n} \tag{5}$$

For example, matrix A_3 of paired comparisons of responses by expert No. 3 based on the scale of importance of estimates [14, 17] is as follows:

$$A_3 = \begin{pmatrix} 1 & 3 & 4 & 5 & 7 & 9 \\ 0.33 & 1 & 2 & 3 & 5 & 8 \\ 0.25 & 0.5 & 1 & 2 & 4 & 7 \\ 0.2 & 0.33 & 0.5 & 1 & 2 & 5 \\ 0.14 & 0.2 & 0.25 & 0.5 & 1 & 2 \\ 0.11 & 0.12 & 0.14 & 0.2 & 0.5 & 1 \end{pmatrix}. \quad (6)$$

As a result of calculations, eigenvalues of matrix A_3 are obtained: $\lambda_1 = 6.177$, $\lambda_2 = -4.781*10^{-4} + 1.084i$; $\lambda_2 = -4.781*10^{-4} - 1.084i$; $\lambda_4 = -0.064$; $\lambda_5 = -0.056 + 0.129i$; $\lambda_6 = -0.056 - 0.129i$, where $\lambda_{max} = \lambda_1 = 6.177$.

Then, it is necessary to find the eigenvector of matrix A_3 based on the equation:

$$\begin{pmatrix} 1-6.177 & 3 & 4 & 5 & 7 & 9 \\ 0.33 & 1-6.177 & 2 & 3 & 5 & 8 \\ 0.25 & 0.5 & 1-6.177 & 2 & 4 & 7 \\ 0.2 & 0.33 & 0.5 & 1-6.177 & 2 & 5 \\ 0.14 & 0.2 & 0.25 & 0.5 & 1-6.177 & 2 \\ 0.11 & 0.12 & 0.14 & 0.2 & 0.5 & 1-6.177 \end{pmatrix} * \begin{pmatrix} \omega_1 \\ \omega_2 \\ \omega_3 \\ \omega_4 \\ \omega_5 \\ \omega_6 \end{pmatrix} = 0. \quad (7)$$

Consider the introduction of the normalization requirement: $\omega_1 + \omega_2 + \omega_3 + \omega_4 + \omega_5 + \omega_6 = 1$. A system of equations is obtained:

$$\begin{aligned} &-5.177\omega_1 + 3\omega_2 + 4\omega_3 + 5\omega_4 + 7\omega_5 + 9\omega_6 = 0 \\ &0.33\omega_1 - 5.177\omega_2 + 2\omega_3 + 3\omega_4 + 5\omega_5 + 8\omega_6 = 0 \\ &0.25\omega_1 + 0.5\omega_2 - 5.177\omega_3 + 2\omega_4 + 4\omega_5 + 7\omega_6 = 0 \\ &0.2\omega_1 + 0.33\omega_2 + 0.5\omega_3 - 5.177\omega_4 + 2\omega_5 + 5\omega_6 = 0 \\ &0.14\omega_1 + 0.2\omega_2 + 0.25\omega_3 + 0.5\omega_4 - 5.177\omega_5 + 2\omega_6 = 0 \\ &0.11\omega_1 + 0.12\omega_2 + 0.14\omega_3 + 0.2\omega_4 + 0.5\omega_5 - 5.177\omega_6 = 0 \end{aligned} \quad (8)$$

System of equations (8) has only a trivial solution. To determine eigenvector W, one of the equations of system (8) is substituted by the normalization requirement. Having solved the new system of equations, eigenvector W of matrix A_3 is obtained:

$$w_1 = 0.451;\ w_2 = 0.229;\ w_3 = 0.153;$$
$$w_4 = 0.092;\ w_5 = 0.048;$$
$$w_6 = 0.027,\ (at \lambda_{max} = 6.177).$$

$$\sum_{i=1}^{6} w_i = 1$$

Values w_i (i = 1, 2, ... 6), forming eigenvector W, are taken to be a degree of confirmity of responses by expert No. 3 for the fuzzy set.

Having calculated the eigenvectors of the matrices of paired comparisons of expert responses, the following sets are obtained:

$$C_1 = \begin{Bmatrix} 0.089/A;\ 0.152/B;\ 0.414/C; \\ 0.254/D;\ 0.059/E;\ 0.032/F \end{Bmatrix}$$
$$C_2 = \begin{Bmatrix} 0.024/A;\ 0.079/B;\ 0.405/C; \\ 0.286/D;\ 0.046/E;\ 0.16/F \end{Bmatrix}$$
$$C_3 = \begin{Bmatrix} 0.092/A;\ 0.048/B;\ 0.451/C; \\ 0.153/D;\ 0.229/E;\ 0.027/F \end{Bmatrix}$$
$$C_4 = \begin{Bmatrix} 0.239/A;\ 0.132/B;\ 0.239/C; \\ 0.076/D;\ 0.076/E;\ 0.239/F \end{Bmatrix}$$
$$C_5 = \begin{Bmatrix} 0.057/A;\ 0.132/B;\ 0.324/C; \\ 0.181/D;\ 0.027/E;\ 0.278/F \end{Bmatrix}$$
$$C_6 = \begin{Bmatrix} 0.23/A;\ 0.121/B;\ 0.23/C; \\ 0.121/D;\ 0.23/E;\ 0.07/F \end{Bmatrix}$$
$$C_7 = \begin{Bmatrix} 0.032/A;\ 0.089/B;\ 0.414/C; \\ 0.254/D;\ 0.152/E;\ 0.059/F \end{Bmatrix}$$
$$C_8 = \begin{Bmatrix} 0.094/A;\ 0.049/B;\ 0.277/C; \\ 0.412/D;\ 0.143/E;\ 0.025/F \end{Bmatrix}$$
$$C_9 = \begin{Bmatrix} 0.098/A;\ 0.053/B;\ 0.453/C; \\ 0.139/D;\ 0.228/E;\ 0.029/F \end{Bmatrix}$$
$$C_{10} = \begin{Bmatrix} 0.038/A;\ 0.066/B;\ 0.375/C; \\ 0.143/D;\ 0.143/E;\ 0.236/F \end{Bmatrix}$$
$$C_{11} = \begin{Bmatrix} 0.214/A;\ 0.088/B;\ 0.214/C; \\ 0.349/D;\ 0.046/E;\ 0.088/F \end{Bmatrix}$$
$$C_{12} = \begin{Bmatrix} 0.059/A;\ 0.032/B;\ 0.414/C; \\ 0.254/D;\ 0.152/E;\ 0.089/F \end{Bmatrix}. \quad (9)$$

Then, the choice rule is used:

$$\begin{aligned} D = \{ & min \begin{pmatrix} 0.089;\ 0.024;\ 0.092;\ 0.239;\ 0.057;\ 0.23; \\ 0.032;\ 0.094;\ 0.098;\ 0.038;\ 0.214;\ 0.059 \end{pmatrix} / A; \\ & min \begin{pmatrix} 0.152;\ 0.079;\ 0.048;\ 0.132;\ 0.132;\ 0.121; \\ 0.089;\ 0.049;\ 0.053;\ 0.066;\ 0.088;\ 0.032 \end{pmatrix} / B; \\ & min \begin{pmatrix} 0.414;\ 0.405;\ 0.451;\ 0.239;\ 0.324;\ 0.23; \\ 0.414;\ 0.277;\ 0.453;\ 0.375;\ 0.214;\ 0.414 \end{pmatrix} / C; \\ & min \begin{pmatrix} 0.254;\ 0.286;\ 0.153;\ 0.076;\ 0.181;\ 0.121; \\ 0.254;\ 0.412;\ 0.139;\ 0.143;\ 0.349;\ 0.254 \end{pmatrix} / D; \\ & min \begin{pmatrix} 0.059;\ 0.046;\ 0.229;\ 0.076;\ 0.027;\ 0.23; \\ 0.152;\ 0.143;\ 0.228;\ 0.143;\ 0.046;\ 0.152 \end{pmatrix} / E; \\ & min \begin{pmatrix} 0.032;\ 0.16;\ 0.027;\ 0.239;\ 0.278;\ 0.07; \\ 0.059;\ 0.025;\ 0.029;\ 0.236;\ 0.088;\ 0.089 \end{pmatrix} / F \} = \\ & = \begin{Bmatrix} 0.024/A;\ 0.032/B;\ 0.214/C; \\ 0.076/D;\ 0.027/E;\ 0.025F \end{Bmatrix} \end{aligned} . \quad (10)$$

According to the rule of max(min), it has been found that the highest priority of the directions of innovative development considered by experts on the basis of the fuzzy set theory is alternative C (development of workers' skills). The second place is taken by alternative D (the improvement of the marketing system) and the third place – by alternative B (the introduction of advanced materials and technologies).

The other three alternatives (E – the construction and repair of production facilities, F – the purchase and installation of modern equipment, A – the production of vessels of new designs) occupy the places from 4 to 6, respectively, and in respect to preference they differ little from each other.

To make conclusions that most accurately reflect the consolidated opinion of the expert commission, it is necessary to follow the general scientific concept of stability [19]. The concept of stability is based on the use of different methods of mathematical processing of expert opinions to highlight similar recommendations obtained by these methods. A significant change in recommendations from method to method would indicate a high degree of their dependence on expert subjectivity. Therefore, apart from the fuzzy set theory, to obtain a consolidated opinion of experts three methods of mathematical processing of the responses have also been used: an arithmetic average rank method, a median rank method and the method of group decision making [20] based on the geometric average values of the ranks. In the paper, these three methods are not described in detail as they are traditional. A comparative analysis of the results of processing expert opinions has been performed using all the four methods.

Table 2 shows the ranks of the expert responses to the question about the priorities of alternatives. Rank “1” is assigned to the best alternative, and rank “6” – to an alternative that should be implemented lastly. If an expert considers that two alternatives are equal, have the same estimates and should take the first and second places by preference, they are assigned the same rank – 1.5: (1+2) / 2=1.5.

TABLE 2 The ranks of the expert responses

Directions of innovative development	Experts											
	1	2	3	4	5	6	7	8	9	10	11	12
A	4	6	4	2	5	2	6	4	4	6	2.5	5
B	3	4	5	4	4	4.5	4	5	5	5	4.5	6
C	1	1	1	2	1	2	1	2	1	1	2.5	1
D	2	2	3	5.5	3	4.5	2	1	3	3.5	1	2
E	5	5	2	5.5	6	2	3	3	2	3.5	6	3
F	6	3	6	2	2	6	5	6	6	2	4.5	4

The final ranks of alternatives are calculated as follows. Using the method of arithmetic average of ranks, the sums of ranks assigned by experts to different alternatives are calculated (Table 2). The sums are divided by the number of experts, and the arithmetic average of ranks is obtained. Final rank of “1” is assigned to the smallest sum, and the final rank of “6” – to the largest one. By the median method, ranks of the expert responses for each alternative initially are located in non-decreasing order. Then, the sum of ranks in the mean position (the sixth and seventh places) of variational series is divided in two, and a median of ranks is obtained. The final ranks obtained by the median method as well as by the arithmetic average method are assigned by using the same rule. By the method of group decision making, geometric average of ranks for different alternatives has been calculated. The final ranks have been assigned according to the described rule. Results of calculation of the final ranks of alternatives are presented in Table 3.

TABLE 3 Final ranks of alternatives calculated by different methods

Alternatives	A	B	C	D	E	F
The final rank by the arithmetic average	4	6	1	2	3	5
The final rank by medians	4	5	1	2	3	6
The final rank by the geometric average	4	6	1	2	3	5
The final rank by the fuzzy set theory	6	3	1	2	4	5
The grand total by the geometric average	4	5	1	2	3	6

It has been found that the final ranks of alternatives by the arithmetic average method and the geometric average method completely coincide (Table 3). Final ranks by the median method differ from the two mentioned above for alternatives B and F (5th and 6th ranks, respectively rather than 6^{th} and 5^{th} ranks). As a result of the four methods of calculation, alternatives C and D have taken the first place. For the grand total ranking of alternatives, the method of group decision making has been used, which enables one to obtain results that are equidistant from the maximum and minimum estimates. According to the grand total, alternative E has taken the third place. As far as the third place is concerned, there is only a slight deviation by the fuzzy set theory. Therefore, it can be stated that for the first three places the consolidated expert opinion rather well complies with the concept of stability. For the 4th, 5th and 6th places, there are some discrepancies in the final ranks obtained by different methods of calculation. In general, it can be stated that the consolidated opinion of independent experts, according to the calculations, is quite unanimous. The authors understand that this opinion is not the final authority, as in the final decision-making process the enterprises within the industry should take into account the specific conditions, the availability of funding, the market situation, etc.

4 Conclusions

The research has allowed identifying the most important directions of innovative development of the shipbuilding and ship repair industry. It has been found that at present the most topical directions of innovations in the shipbuilding industry are the development of workers’ skills and improvement of the marketing system. There is an urgent need for the construction of new production facilities and repair of the existing ones. These main directions of innovations meet the first priority requirements of the industry and are necessary to improve its competitiveness. Without progress in the first three main directions of innovations, the successful development of the industry in all other directions is not possible.

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