

Ranking of transport companies innovative activity

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Abstract. Methodological basis for assessing the innovative potential of transport companies is based on the use of the ranking model. This model is used to determine the ranking of innovative potential of the company, taking into account a number of key internal and external indicators of its activities. The proposed ranking model for determining the innovative potential has been tested in three existing transport companies of Tyumen. The testing confirms the universality of the procedure of the ranking score and makes it possible to use it in practice. The indicator allows assessing the position of the transport company and developing a strategy for its further development.

1 Introduction

Comprehensive innovative development of the business entities of all branches will ensure the formation of a competitive and sustainable market economy as a whole. The main direction of the economy's innovative development is the conservation of natural and material resources, automation of processes and reduction of losses. The transport industry is one of the key sectors of the country's economy. It creates an opportunity for the activities of most production areas, thus the promotion of this sector should be a priority. At the current stage of development of economic systems, the innovation is considered to be a key factor in the growth of production of any level of complexity and productivity. Respectively, the development of the transport industry should also have an innovative focus.

The majority of scientific works consider some aspects of the formation of the innovative environment of a business entity, the rationale for approaches to its creation and the identification of parameters by which one can determine the innovative potential of the enterprise.

Researches in the field of transport are presented by the works of such scientists as Balalaeva A. S., Bowersocks D.J., Borodin A. F., Gerami V. D., Zyryanov V. V., Evseev O. V., Eliseev, S. Yu., Zheleznov D. V. Zubkov V. N., Kloss D. J., Kirillova A. G., Kozlov P. A., Korovyakovsky E. K., Larin O. N., Levin B. A., Mamaev E. A., Mirotin L. B., Nikolashin V. M., Persianov V. A., Petrov M. B., Pekhterev F. S., Pravdin N. V., Prokofieva T. A., Rezer S.M., Sai V. I., etc. [1-13]

Such scientists as Kondratyev N. D., Schumpeter Y., Santo B., Tviss B. have made an invaluable contribution to the study of the role of innovation in modern economic systems,

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etc. Innovation management was studied by such scientists as Porter M., Ansoff I., Drucker P., Grunina O. A., Dobrynin A. I.

Such scientists as Voronin M. I., Doroshenko T. G., Frolova M. A., Zagidullina G. M., Zotova B. V., Karaseva A.V., Kamenetsky M. I., Kulakova Y. N., Lukmanova I.G., devoted their works to consideration of issues of innovative development in various industries. The study of clusters of the respective regions in the current market conditions and the problems of their functioning was considered in the context of the works of the following authors: Belalov V. A., Biryukov A. V., Ignatyuk N. A., Kalyuzhnova N. Y., Leontiev V. B., Moleva O. V., Monastyryna E. A., Rygalin D. B., Sosna S.A., Tikhomirov Yu. A., Urazaev R. I., Sharov V.A. [1-19]

Close attention to the problems of innovative development of the transport industry business entities is paid by both the state and the academic community. But, nevertheless, many theoretical and methodological aspects of the innovation environment formation require additional research, taking into account the territorial principle, the time factor, the factors-incentives and factors-constraints of the business entities innovative activity, as well as the synergetic effect creation.

Thus, the assessment of innovative potential of the business entities of the transport industry in the dynamics in order to monitor the innovative development of individual companies and the economy as a whole remains an important issue. To date, a sufficient number of points of view on the ways and methods of assessing the enterprise's innovative potential have been developed. Both private and general indicators characterizing the level of innovative potential of a business entity have been developed. Economists Misko K.S., Kanygin Y. M., Kulvets P. A. give the preference to the system of private indicators of innovation potential.

2 Methods

According to the authors, the most objective method of estimation of innovative potential is the estimation using the generalized indicator of innovation activity of the company by ranking score assessment on the basis of relative indicators. The ranking is presented by the scoring system for assessing the innovative potential of the company. The ranking method is used to determine the company's position among competitors in the same industry. In addition, this method of analysis is used in the internal evaluation of the structural units of the company. The result of using the method of multivariate ranking is the calculation of the generalized indicator of the innovation potential of the business entity of the transport industry on the basis of two components: the weighted average value of the indicator for each group of indicators and the standard deviation of indicators for each group of indicators. [14]

The companies' innovative activity ranking score is calculated in stages.

Stage 1. Selection of indicators for ranking. At this stage, the selection of indicators for ranking is performed. It should be borne in mind that upon all the variety of indicators, they can be combined into homogeneous groups; it is not advisable to use indicators belonging to different groups for ranking. The author proposes indicators of the external environment, depending on the state, regional and sectoral impact, as well as indicators of the internal environment of the business entity: social, organizational and management, productive-economic, technological.

Stage 2. Selection of companies for ranking. At this stage, we consider competitor companies of the same industry, similar to each other in terms of the main qualitative and quantitative characteristics.

Stage 3. Selection of the companies' comparison factors, determination of indicators both for the chosen company and for the sample as a whole. The weighting factors are assigned in fractions of a unit.

Stage 4. Standardization of indicators. All indicators are standardized using the following statistical model:

$$K_{ij}^{\text{stand}} = \frac{K_{ij}}{K_i} \quad (1)$$

$$K_i = \sum_{j=1}^m K_{ij} \quad (2)$$

K_{ij}^{stand} - the i -th indicator value, characterizing innovation activity in j company after standardization; K_i - the sum of i -th indicator, characterizing the innovative activity of the transport company; i - sequence number of the indicator, characterizing the innovative activity of the company, $i = \underline{1, n}$; j - order number of the evaluated company, $j = \underline{1, m}$.

Stage 5. Identification of deviations of indicators from the standard. The deviation of the indicator from the standard is calculated using the formula (3):

$$K_{ij}^{\text{dev}} = 1 - K_{ij}^{\text{stand}} \quad (3)$$

K_{ij}^{dev} - value of the deviating indicator from the standard of the i -th indicator characterizing innovative activity in j company.

Stage 6. Calculation of the square of deviation of indicators from the standard using the formula (4):

$$K_{ij}^{\text{sq}} = K_{ij}^{\text{dev}^2} \quad (4)$$

Stage 7. Calculation of the sum of squares of deviation of indicators of innovative activity of the j company from the standard using the formula (5):

$$K_j^{\text{total}} = \sum_{i=1}^m K_{ij}^{\text{sq}} \quad (5)$$

Stage 8. The calculation of the ranking of deviations of indicators of innovation activity of the j company from the standard is carried out using the formula (6):

$$K_j^R = \sqrt{K_j^{\text{total}}} \quad (6)$$

Stage 9. Ranking: $\min K_j^R = \min R_j$; $\max K_j^R = \max R_j$

Correlation is used to quantify the relationships between indicators in statistics. In general terms, the correlation is a value that reflects the presence of connectivity between factors, processes, as well as indicators characterizing them. This connectivity is called correlation and determines the dependence of the average value of one indicator on the change in the value of another. The following forms of correlation between the indicators are distinguished:

1. causal dependence of the effective feature on the variation of the factor characteristic;
2. correlation between two consequences that are a common cause;
3. the connectivity of indexes, which both are cause and an effect.

In general terms the statistical model for calculating the ranking of innovative potential of transport companies has the following form (7):

$$K_j^R = \sqrt{\sum_{i=1}^n \left(1 - \frac{K_{ij}}{\sum_{j=1}^m K_{ij}}\right)^2} \quad (7)$$

The indicators characterizing the innovative potential of the company, taken into account in the construction of its ranking model, are presented in the table. 1. [15,16]

Table 1. Indicators characterizing the innovative potential of the transport company.

| Designation of indicator | Name of the indicator |
|--------------------------|--|
| K1 | competitiveness |
| K2 | product/service demand by industry |
| K3 | the level of state support |
| K4 | level of socio-economic development of the region |
| K5 | economic situation in the whole industry |
| K6 | indicator of business confidence in the industry |
| K7 | the average level of capacity utilization |
| K8 | level of involvement of the company's employees |
| K9 | timely payment of wages |
| K10 | the proportion of employees involved in innovation activities |
| K11 | the frequency of conducting marketing research |
| K12 | the proportion of highly qualified personnel |
| K13 | the proportion of intangible assets in total cost of fixed capital |
| K14 | active participation in contract tenders and competitions |
| K15 | the customer loyalty level |
| K16 | execution of orders |
| K17 | the volume of execution of the orders under contracts |
| K18 | labour productivity per worker |
| K19 | profitability |
| K20 | financial stability |
| K21 | level of human resources |
| K22 | level of provision of material and technical means |
| K23 | level of specialization of the transport company |
| K24 | the uniformity of performance of works / services |
| K25 | deviation in terms of performance of work / services |
| K26 | application of effective methods and technology |
| K27 | level of automation of transport processes |
| K28 | quality of work / services |
| K29 | compliance with accident prevention rules and occupational safety |
| K30 | the transport documentation quality |

The model of determining the ranking indicator of the innovative potential of transport companies allows to connect all the factors of the external and internal environment affecting the innovative potential, and accordingly to determine the possibilities of its innovative development.

3 Assessment and results

The innovative activity ranking was carried out among three major transport companies of the Tyumen region (the Artel, LLC, the Luch, LLC, the Tyumen Transport Company, LLC) operating in conditions of market competition.

In the course of the study, in order to collect and analyze information for the calculation of indicators of external factors of influence on the formation of innovative potential of transport companies, public information and analytical data posted on the official website of the Federal State Statistics Service was also used. This data was first used to calculate the specific indicators characterizing the innovative potential of each transport company, and then a generalizing indicator.

In the course of the study, a comprehensive multivariate analysis of the financial, production, organizational and management activities of companies, as well as their social orientation, taking into account the interaction between them was carried out.

To calculate the ranking of innovation potential, the selection of indicators that affect the formation of the innovative potential of the company was made. It is assumed that factors of external influence, such as the demand for transport services in the industry, the average level of capacity utilization in the industry, the level of state support, the level of socio-economic development of the region, the economic situation in the industry as a whole, the level of entrepreneurial confidence, equally affect all companies selected for the analysis of innovative potential. This assumption was made due to the fact that in the process of sampling companies for the subsequent calculation of the ranking of their innovative potential three transport companies, similar to each other in the main economic, industrial, technical and other characteristics of the activity were selected.

The next stage was the standardization of all indicators characterizing the innovative potential of transport companies, that is, bringing their digitized values to a comparable form.

At the third stage of calculating the ranking of the innovation potential of the analyzed transport companies, the deviation of the indicators of innovation from the standard was calculated, followed by its squaring, the calculation of the sums of the squares of deviations from the standard.

The analyzed transport companies are assigned the following serial numbers:

- 1 – the Artel, LLC;
- 2 – the Luch, LLC;
- 3 – The Tyumen Transport Company, LLC.

The results of the standardization of indicators, the values of deviations from the standardized indicators and the values of the squared deviations from the standardized indicators are shown in the Table 2.

Table 2. Standardization of indicators characterizing the innovative potential of the transport company and assessment of deviations from the standardized indicators.

| Indicator | K _{ij} | | | K _{ij} ^{stand} | | | K _{ij} ^{dev} | | | K _{ij} ^{sq} | | | Rank | | |
|-----------------|-----------------|--------|--------|----------------------------------|-------|------|--------------------------------|------|------|-------------------------------|------|------|------|---|---|
| | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| K ₁ | 1 | 0.9 | 1 | 0.34 | 0.31 | 0.34 | 0.66 | 0.69 | 0.66 | 0.43 | 0.48 | 0.43 | 3 | 3 | 3 |
| K ₂ | 0.6 | 0.1 | 0.3 | 0.60 | 0.10 | 0.30 | 0.40 | 0.90 | 0.70 | 0.16 | 0.81 | 0.49 | 4 | 1 | 3 |
| K ₃ | 0.1 | 0.03 | 0.15 | 0.36 | 0.11 | 0.54 | 0.64 | 0.89 | 0.46 | 0.41 | 0.80 | 0.22 | 3 | 1 | 3 |
| K ₄ | 0.6 | 0.55 | 0.59 | 0.34 | 0.32 | 0.34 | 0.66 | 0.68 | 0.66 | 0.43 | 0.47 | 0.44 | 3 | 3 | 3 |
| K ₅ | 0.1 | 0.01 | 0.13 | 0.42 | 0.04 | 0.54 | 0.58 | 0.96 | 0.46 | 0.34 | 0.92 | 0.21 | 3 | 1 | 3 |
| K ₆ | 0.24 | 0.25 | 0.35 | 0.29 | 0.30 | 0.42 | 0.71 | 0.70 | 0.58 | 0.51 | 0.49 | 0.34 | 3 | 3 | 4 |
| K ₇ | 100 | 100 | 100 | 0.33 | 0.33 | 0.33 | 0.67 | 0.67 | 0.67 | 0.44 | 0.44 | 0.44 | 4 | 4 | 4 |
| K ₈ | 82400 | 80687 | 285350 | 0.18 | 0.18 | 0.64 | 0.82 | 0.82 | 0.36 | 0.67 | 0.67 | 0.13 | 2 | 1 | 4 |
| K ₉ | 1 | 0.81 | 0.72 | 0.40 | 0.32 | 0.28 | 0.60 | 0.68 | 0.72 | 0.37 | 0.46 | 0.51 | 4 | 3 | 3 |
| K ₁₀ | 26 | -3 | 6 | 0.90 | -0.10 | 0.21 | 0.10 | 1.10 | 0.79 | 0.01 | 1.22 | 0.63 | 4 | 1 | 2 |
| K ₁₁ | 7.9 | 6 | 8 | 0.36 | 0.27 | 0.37 | 0.64 | 0.73 | 0.63 | 0.41 | 0.53 | 0.40 | 3 | 3 | 3 |
| K ₁₂ | 1 | 1 | 1 | 0.33 | 0.33 | 0.33 | 0.67 | 0.67 | 0.67 | 0.44 | 0.44 | 0.44 | 4 | 4 | 4 |
| K ₁₃ | 1 | 0.9 | 1 | 0.34 | 0.31 | 0.34 | 0.66 | 0.69 | 0.66 | 0.43 | 0.48 | 0.43 | 3 | 3 | 3 |
| K ₁₄ | 0.65 | 0.47 | 0.92 | 0.32 | 0.23 | 0.45 | 0.68 | 0.77 | 0.55 | 0.46 | 0.59 | 0.30 | 3 | 3 | 4 |
| K ₁₅ | 0.47 | 0.5 | 0.5 | 0.32 | 0.34 | 0.34 | 0.68 | 0.66 | 0.66 | 0.46 | 0.44 | 0.44 | 3 | 3 | 4 |
| K ₁₆ | 1 | 0.9 | 1 | 0.34 | 0.31 | 0.34 | 0.66 | 0.69 | 0.66 | 0.43 | 0.48 | 0.43 | 4 | 4 | 4 |
| K ₁₇ | 1.4 | 1.2 | 1 | 0.39 | 0.33 | 0.28 | 0.61 | 0.67 | 0.72 | 0.37 | 0.44 | 0.52 | 4 | 3 | 3 |
| K ₁₈ | 0.32 | 0.36 | 0.67 | 0.24 | 0.27 | 0.50 | 0.76 | 0.73 | 0.50 | 0.58 | 0.54 | 0.25 | 3 | 3 | 4 |
| K ₁₉ | 0.47 | 0.37 | 0.46 | 0.36 | 0.28 | 0.35 | 0.64 | 0.72 | 0.65 | 0.41 | 0.51 | 0.42 | 3 | 3 | 3 |
| K ₂₀ | 0.03 | 0.05 | 0.08 | 0.19 | 0.31 | 0.50 | 0.81 | 0.69 | 0.50 | 0.66 | 0.47 | 0.25 | 3 | 3 | 3 |
| K ₂₁ | 0.7 | 0.05 | 0.67 | 0.49 | 0.04 | 0.47 | 0.51 | 0.96 | 0.53 | 0.26 | 0.93 | 0.28 | 3 | 1 | 3 |
| K ₂₂ | 0.01 | 0.03 | 0.05 | 0.11 | 0.33 | 0.56 | 0.89 | 0.67 | 0.44 | 0.79 | 0.44 | 0.20 | 1 | 3 | 3 |
| K ₂₃ | 0.15 | 0.33 | 0.33 | 0.19 | 0.41 | 0.41 | 0.81 | 0.59 | 0.59 | 0.66 | 0.35 | 0.35 | 3 | 3 | 3 |
| K ₂₄ | 0.04 | 0.01 | 0.06 | 0.36 | 0.09 | 0.55 | 0.64 | 0.91 | 0.45 | 0.40 | 0.83 | 0.21 | 4 | 4 | 4 |
| K ₂₅ | -21.25 | -21.25 | -21.25 | 0.33 | 0.33 | 0.33 | 0.67 | 0.67 | 0.67 | 0.44 | 0.44 | 0.44 | 2 | 2 | 2 |
| K ₂₆ | 63.75 | 63.75 | 63.75 | 0.33 | 0.33 | 0.33 | 0.67 | 0.67 | 0.67 | 0.44 | 0.44 | 0.44 | 4 | 4 | 4 |
| K ₂₇ | 12.14 | 12.14 | 12.14 | 0.33 | 0.33 | 0.33 | 0.67 | 0.67 | 0.67 | 0.44 | 0.44 | 0.44 | 4 | 4 | 4 |
| K ₂₈ | 1.02 | 1.02 | 1.02 | 0.33 | 0.33 | 0.33 | 0.67 | 0.67 | 0.67 | 0.44 | 0.44 | 0.44 | 4 | 4 | 4 |
| K ₂₉ | -1.25 | -1.25 | -1.25 | 0.33 | 0.33 | 0.33 | 0.67 | 0.67 | 0.67 | 0.44 | 0.44 | 0.44 | 2 | 2 | 2 |
| K ₃₀ | -5 | -5 | -5 | 0.33 | 0.33 | 0.33 | 0.67 | 0.67 | 0.67 | 0.44 | 0.44 | 0.44 | 2 | 2 | 2 |

The calculation of the overall deviation ranking is calculated by applying the standard deviation formula.

Table 3. Ranking of deviations from the standardized indicator.

| Indicator | 1 | 2 | 3 |
|----------------------|-------|-------|-------|
| K_j^{total} | 13.21 | 16.90 | 11.43 |
| K_j^R | 3.64 | 4.11 | 3.38 |
| Rank | 2 | 3 | 1 |

Table 4. Overall ranking of innovative activity of transport companies in 2017.

| Indicator | 1 | 2 | 3 |
|-----------|----|----|----|
| R_j | 95 | 82 | 98 |
| Rank | 2 | 3 | 1 |

In figure 1, the obtained ranking values of the innovative potential of transport companies are presented in the form of a histogram.

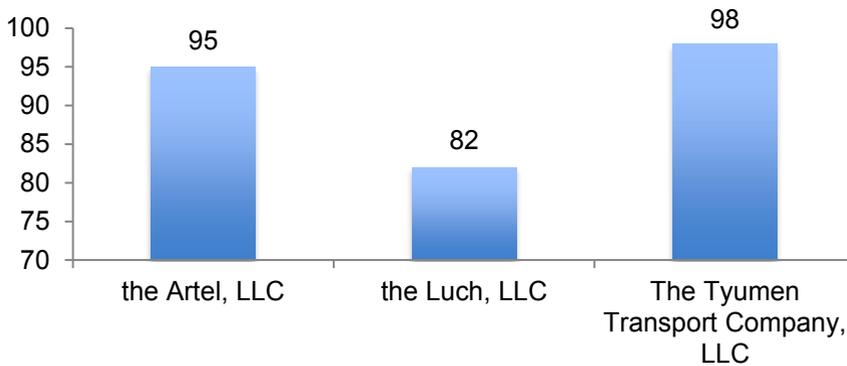


Fig. 1. The histogram of the values of the ranking of the transport companies innovative potential.

4 Conclusions

As a result of the study on determining the ranking indicator of the innovative potential of transport companies, it can be noted that the Tyumen Transport Company, LLC, has taken a leading position. The ranking indicator of the innovative potential of transport companies can be calculated in dynamics (by year, half-year, quarter) to monitor the innovative activity of the company.

The model of calculating the ranking of innovative potential of business entities of the construction industry can be applied ^[1] at the municipal level to identify companies with low innovative potential for the purpose of further development of measures to stimulate their innovative activities. Moreover, the proposed ranking assessment will be useful at the level of any business entity: to determine its competitive position among other participants in the economic activities of the various sectors, as well as to analyze the level of innovation potential of internal structural units for the subsequent development of an innovation strategy.

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