Mariya V. Mazunina[1]

Aleksandr G. Rubin

Natalia V. Zinchenko

Natalia N. Gribok

Marina A. Vorobyova

A RISK-ORIENTED APPROACH TO QUALITY MANAGEMENT DURING THE IMPLEMENTATION OF INNOVATIVE PROJECTS FOR COMPANY'S STRATEGIC DEVELOPMENT: WAYS TO INCREASE EFFECTIVENESS

Abstract: This paper is devoted to development of a risk-oriented approach to quality management during the implementation of innovative projects for strategic development of a company, which ensures the growth of effectiveness of this management. This work considers quality as the basis of company's strategic development - competitiveness and commercial effectiveness of a company are treated as the functions of quality. Due to this, focus is made not on standard and generally accessible but on unique aspects of quality, which cannot be achieved by rivals - sustainable competitive advantages. Also, this work considers the specifics of quality in the conditions of the digital economy and focuses on hi-tech character products as the basis of its quality, provided by breakthrough innovations. The risks that are inherent to innovative projects, which are implemented in entrepreneurship, are taken into account. It is offered to manage quality with their help. Based on the developed proprietary scale for classifying the levels and qualitative treatment of effectiveness of quality management during the implementation of innovative projects for company's strategic development and with the help of regression analysis it is proved that in countries with developed market economy the effectiveness of quality management during the implementation of innovative projects from the positions of company's strategic development is moderate – not high – thus requiring certain increase. In order to solve this problem, a risk-oriented approach to quality management during the implementation of innovative projects for company's strategic development is offered.

Keywords: quality management; risk-oriented approach; innovative projects; strategic development; company; effectiveness.

1. Introduction

Quality is the most important landmark during the implementation of innovative projects for company's strategic development. This is due to the fact that only high quality of products allows a company to attract new consumers and to keep the

---

[1] Corresponding author: Mariya V. Mazunina
  Email: MVMazunina@fa.ru

existing customers in the long-term. The opportunities of pricing competition become more limited in the course of growth of the concentration of global and foreign markets under the influence of globalization and implementation of the freetrading concept in most countries of the world. An important role in this process belongs to the World Trade Organization, which creates favorable conditions and sets requirements to its participants (164 countries as of 2020) regarding the cancelling of customs limitations.

In case of similar prices for supporting a company's competitiveness and its high commercial effectiveness, quality should be not just high (which allows for similarly high quality with all market players) but higher than with the rivals. That's why from the positions of company's strategic development, uniqueness – as a characteristic of products' quality – is very important. In the modern economic conditions, innovations are aimed at creation of unique (not copied by the rivals) competitive advantages. In view of the digital context of the modern market economy and functioning of entrepreneurship in the conditions of the Fourth technological mode, the unique competitive advantages could be provided by the following aspects of products' quality.

1st aspect: robotization. Automatization based on robots allows increasing the precision of production, thus improving technical characteristics of products. "Smart" companies manufacture hi-tech products, which satisfy the consumers' needs to a larger extern and pose a high value, as compared to regular (low-tech) products. In addition to this, replacement of human labor with authomatization based on robots ensures high safety of production (e.g., risk of production injuries is brought down to zero). Robotization allows achieving a high level of corporate social responsibility, which is an important component of products' quality for a lot of modern consumers (humane production). Another

advantage of robots is the possibility to develop standardized production with a guarantee of certain quality, which is unchanged (similar) for all products (absence of defects).

2nd aspect: use of AI and Big data. Automatized corporate accounting allows forming large-scale internal data bases (big data) for full information support for managerial decisions. During authomatization of management based on AI, a more precise expenditure of resources and materials is achieved – as well as increased control and reduction of production waste. This allows improving the technical features of the manufactured products and increasing its eco-friendliness – which improves quality. Use of Big data and AI in the marketing practice allows collecting detailed information on the target market and, in particular, on consumer preferences. This allows for a more optimal choice, starting and implementing innovations that are most popular and that provide the best advantages for consumers.

3rd aspect: hi-tech export. The volume of export shows the level of demand for products in the world markets. The higher the global demand, the higher the level of quality. Innovations allow expanding the company's assortment and/or assigning its products with qualities that are popular with different groups of target consumers, due to which it will be of higher demand in the world markets. Export of products to countries with more progressive society is a sign of better quality of products, for they are in demand among more sophisticated consumers.

These advantages for quality of products are not always achieved as a result of the implementation of innovative projects in entrepreneurship. Here we offer a hypothesis H_0 that they depend on effectiveness of quality management. In the process of a company's innovative activities there emerge risks: the advantages for quality are either not achieved or are of the

contradictory character, i.e., improve quality in one aspect but reduce in another aspect. This determines the importance of development and implementation of risk-oriented approach to quality management during the implementation of innovative projects for strategic development of a company, which ensures the growth of effectiveness of this management.

This work considers quality as the basis of a company's strategic development – competitiveness and commercial effectiveness of a company are treated as functions of quality. Due to this, the emphasis is made not on standard and generally accessible but on unique aspects of quality, which cannot be achieved by rivals - sustainable competitive advantages. Also, this work takes into account the specifics of quality in the conditions of the digital economy and focuses on hi-tech character of products as the basis of its quality, provided by breakthrough innovations. The risks, inherent to innovative projects that are implemented in entrepreneurship are taken into account. They should be considered during quality management.

The article consists of the following structural parts: introduction; literature review; results, which consist of three parts: 1) analysis of the dependence of consequences for quality (effectiveness) on management of innovative projects in entrepreneurship, 2) determining the approaches to quality management during the implementation of innovative projects and their comparison from the positions of the contribution to strategic development of a company, 3) substantiation of the optimal – risk-oriented - approach, which ensures the highest effectiveness of quality management during the implementation of innovative projects for company's strategic development; conclusions.

2. Literature Review

The theory and practice of quality management are studied and reflected in a lot of published works. Sedevich-Fons (2018) connects the systems of strategic managerial accounting and quality management in entrepreneurship. Sumardi and Fernandes (2020) note the important influence of quality management on company's effectiveness: quality of services and characteristics of a product as an environment. Bacoup et al. (2018) show the necessity for transition to the expanded system of quality management, which would take into account the digital context of the market environment.

Franz (2018) studies the general management of entrepreneurship in construction and offers a new type – economical quality during realization of construction innovative projects. Moschidis et al. (2018) recommend conducting multi-dimensional analysis of data for the most precise and correct evaluation of quality and the level of quality management in entrepreneurship (shown by the example of Greece). Uluskan et al. (2018) show the influence of the methods of quality management on readiness to changes due to new realia of quality in the dynamic market environment of the digital economy.

Kucuk Yilmaz (2019) thinks that managing the risks of the transformation process for sustainable corporate management of effectiveness and quality should be based on block-schemes for a conformed educational organization. Kaur et al. (2019) determine synergetic factors of success of general quality management and supply chains management. Mazzuto and Ciarapica (2019) offer a perspective scientific and practical approach to Big data analytics for managing quality, reliability, and risks in entrepreneurship.

Tortorella et al. (2019) point out an intermediary role of an organization in the relations between general quality

management and production indicators (shown by the example of Brazilian industrial companies). Hussain et al. (2019) show a connection between quality management of supply chain and effectiveness of an organization (shown by the example of empirical data of the telecommunication sphere in the UAE).

Phan et al. (2019) thin that the methods of quality management of supply chain influence the operational indicators (based on empirical data from production companies in Vietnam). Ali et al. (2020) show the influence of entrepreneurial orientation, market orientation, and general quality management on efficiency (based on the data of Saudi subjects of small and medium entrepreneurship). Garza-Reyes (2018) offer a systemic approach to diagnostics of the current systems of quality management and business processes.

The interests of company's strategic development in the conditions of the digital economy and Industry 4.0, as well as uniqueness as the key characteristic of quality in the digital environment, are substantiated in the following works. Inshakova and Bogoviz (2020) offer the alternative methods for assessing economic conflicts in the national positive and soft law for strategic development of business. Alpidovskaya and Popkova (2019) reconsider and adapt the provisions of the Marxism theory to the modern realia and prove their applicability to management of strategic development of entrepreneurship in the conditions of the digital economy.

Popkova (2017) studies the economic and legal foundations of the modern Russian society and offers the scientific and practical recommendations for a company's strategic development in the conditions of the digital economy and Industry 4.0. Popkova (2019) outlines the preconditions for formation of Industry 4.0 in the conditions of the knowledge economy for strategic development of entrepreneurship. Popkova (2020) develops a new approach to quality of products and services in the conditions of the knowledge economy, which allows balancing traditions and innovations for company's strategic development.

Popkova et al. (2020) determine the ways of development of marketing of healthcare organizations based on the technology of public-private partnership for strategic development of non-commercial entrepreneurship (shown by the example of Russia). Popkova and Sergi (2020) compare human capital and AI in Industry 4.0 from the positions of company's strategic development (by the example of social entrepreneurship in Russia). Popkova et al. (2017) think that innovations are the basis of marketing strategies of Russian oil companies in the conditions of low oil prices.

Popkova and Sergi (2018) state that Industry 4.0 and other innovations influence a company's strategic development (shown by the example of Russia). Popkova and Sergi (2019) study the complexity and diversity as opposed to rationality in the digital economy, from the positions of strategic development of entrepreneurship. Ragulina (2019) outlines the priorities of development of Industry 4.0 in the modern economic systems with different progress in formation of the knowledge economy knowledge for strategic development of entrepreneurship. Shulus et al. (2020) prove that intellectual production and consumption are a new reality of the 21st century, which determines the specifics of a company's strategic development. Stolyarov et al. (2020) study the digital reality of the modern economy and determine new players and new logic of decision making during strategic development of a company.

The risks for quality that are caused by a company's innovative activities are discussed in the following works. Shahin (2019) draws the connection between quality and innovations and offers creating value for customers with the help of innovations with added value. Conti et al. (2019) show that

innovations that are based on design determine quality and consumer value in production companies. Schniederjans (2018) thinks that innovations in business processes should be oriented at increase of products' quality and optimization of supply and sales chains (added value chains).

Santos et al. (2019) recommend creating value through quality and innovations (based on a thematic study of Portugal). Hosseinzadeh et al. (2020) prove the necessity and offer recommendations for fuzzy combinatorial optimization in a four-dimensional problem of the price-time-quality-risk compromise in one dimension and in another dimension of the context of risks in the ambiguous regime. Mahmoudi and Feylizadeh (2018) develop a mathematical model for solving projects in view of time, cost, quality, risk, and the decreasing returns law.

Khesal et al. (2019) deem it necessary to implement complex management of costs, quality, risks, and schedule through management of earned value. Rosillo-Díaz et al. (2019) perform inter-cultural analysis and determine the connection between the perceived quality of product, perceived risk, and the intent of purchase at the e-commerce products. Simat et al. (2018) note that customer orientation of tourist agencies' employees determines susceptibility to quality of services. Ali (2014) notes the potential of integrating the system of quality evaluation in construction with the system of quality management ISO 9001. Srinivas and Swamy (2013) offer perspective methods of quality management in rural and urban subjects of small and medium entrepreneurship.

An overview of the existing research literature on the set topic shows that its certain components have been studied in detail in the existing publications. However, there is no systemic idea of the set problem. One of the gaps in the accumulated scientific knowledge is uncertainty of risks for quality during the implementation of innovative projects. Another gap is obscurity and insufficient elaboration of the problem of risks management for quality during a company's innovative activities in view of the requirements and company's strategic development, and increase of effectiveness.

Therefore, the problem needs further elaboration, which envisages the developed and justification of a risk-oriented approach to quality management during the implementation of innovative projects for strategic development of a company and increase of effectiveness of quality management.

3. Materials and methodology

In this work, effectiveness is treated from the positions of the level and systemic character of advantages for quality during the implementation of innovative projects in entrepreneurship. The following scale for classification of the levels and qualitative treatment of effectiveness is offered (Figure 1).

As shown in Figure 1, the following levels and qualitative treatments of effectiveness of quality management during the implementation of innovative projects for company's strategic development are distinguished (given in the order of increase of effectiveness – i.e., qualitative improvement):

- Very low effectiveness: when the consequences of innovations for quality are isolated (possibilities of quality management are limited (regression with only one or two aspects above 1 in absolute value, and with other aspects below 1 in absolute value, multiple R≤0.9) and negative (negative regression, i.e., <0);
- Low effectiveness: when the consequences of innovations for quality have the systemic character (regression with all aspects above 1 in absolute value, multiple R>0.9),

but negative (negative regression, i.e., <0);

- Moderate effectiveness: when the consequences of innovations for quality are isolated (possibilities of quality management are limited (regression with only one or two aspects above 1 on absolute value, and with other aspects below 1 in absolute value, multiple R≤0.9),

positive or at least neutral (positive regression – i.e., ≥0).

- High effectiveness: when the consequences of innovations for quality have the systemic character (regression with all aspects above 1 in absolute value, multiple R>0.9) and positive, or at least neutral (positive regression – i.e., ≥0).

Systemic (regression with all aspects above 1 in absolute value, multiple R>0.9)

Low effectiveness of quality management with innovations

High effectiveness of management with innovations

Negative consequences (positive regression, i.e., >0)

Consequences for aspects of quality

Character of consequences

Positive or neutral consequences (negative regression, i.e., ≤0)

Very low (critical) effectiveness of quality management with innovations

Moderate effectiveness of quality management with innovations

Isolated (regression with only one or two aspects above 1 in absolute value, and with other aspects below 1 in absolute value, multiple R≤0.9)
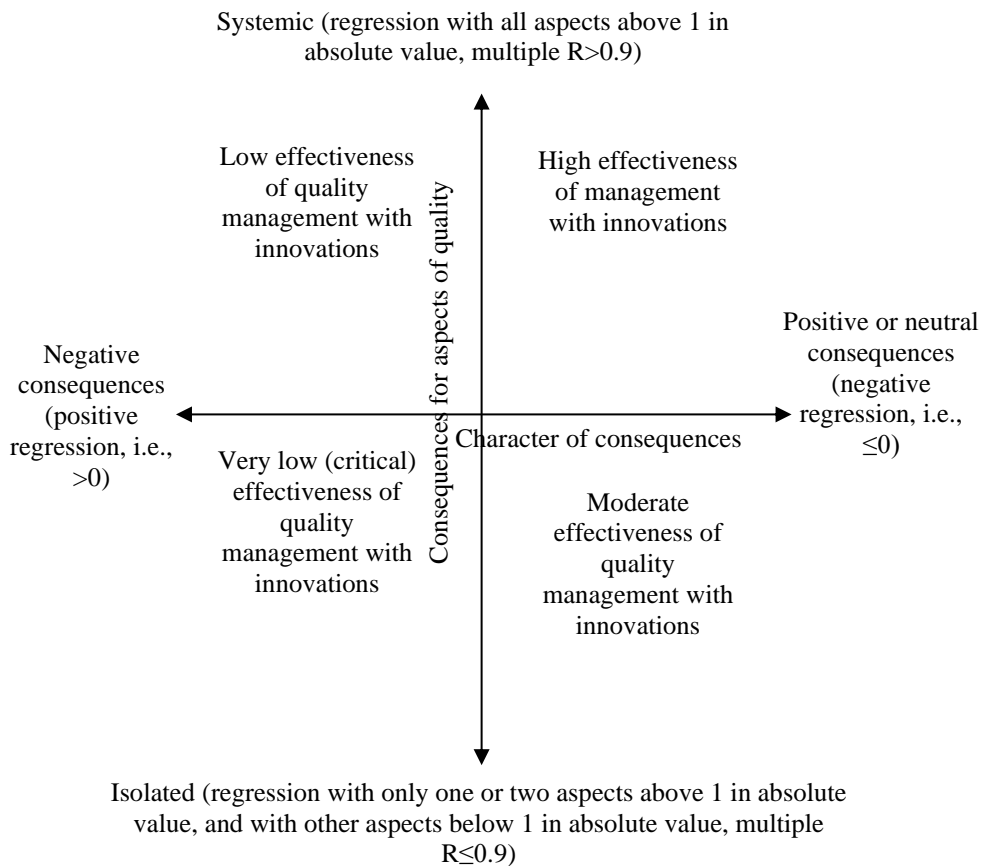
Figure 1. The scale for classification of the levels and qualitative treatment of effectiveness of quality management during the implementation of innovative projects for company's strategic development
Source: developed and compiled by the authors.

It should be noted that target regression is negative (≤0), for results are measured in positions (the lower the number the better),

and factors are measured in points (the higher the number the better).

Regression analysis is used here for analyzing the dependence of the consequences for quality (effectiveness) on management of innovative projects in entrepreneurship. The authors calculated the multiple regression function of the results of innovative projects for quality (they are described in Introduction and include robotization, use of AI, Big data, and hi-tech export) on the characteristics of quality management during the implementation of innovative projects in entrepreneurship, which include the following:
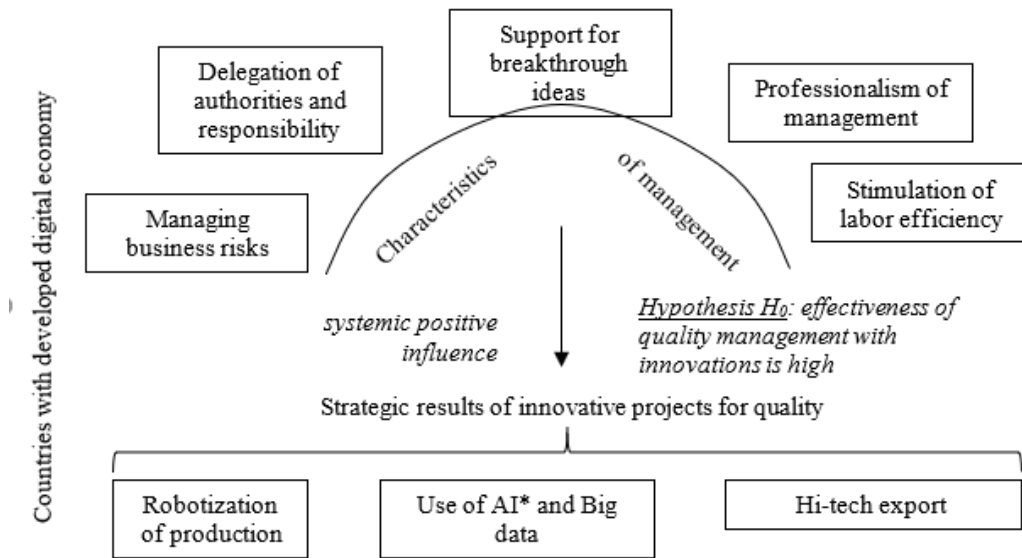
- Management of business risks (Ruiz et all., 2019), which reflects the general effectiveness of a company's approach to risk management, in particular management of risks of innovations for quality;
- Delegation of authorities and responsibility, which shows the effectiveness of team-building of a company and liberalism of management, which is potentially important for quality management during the implementation of innovative projects in entrepreneurship;
- Support for breakthrough ideas, which shows a company's readiness for implementation of progressive technologies and leading innovations, which could be important for strategic (sustainable, long-term) increase of quality in the aspect of uniqueness of a company's products and its business practices;
- Professionalism of management, which characterizes the level of management's competence and its ability for effective quality management during the implementation of innovative projects;

- Stimulation of labor efficiency, which reflects successfulness and sufficiency of motivation of a company's employees for increasing quality with innovations, as well as support for the innovative initiatives of a company's employees.

The working hypothesis of this research (H_0, given in Introduction), from the mathematical point of view, is that the characteristics of management positively influence the quality during the implementation of innovative projects in countries with developed digital economy, which provides high effectiveness of quality management. A logical scheme of this research, which reflects the offered hypothesis, is shown in Figure 2.

For obtaining the most correct results, the research objects are countries with developed digital economy (from the Digital Competitiveness Ranking 2019) from different categories, distinguished by the criterion of the level of digital competitiveness (IMD) and by the criterion of the level of socio-economic development (World Bank): developed countries (leaders of the Digital Competitiveness Ranking), developing countries (moderate digital competitiveness) and underdeveloped countries (the lowest digital competitiveness). The statistics of digital competitiveness in countries of the distinguished categories are shown in Figure 3.

As shown in Figure 3, developed countries are the leaders by the level of digital competitiveness – 97.67 points on average. Developing countries show moderate delay, with their digital competitiveness constituting 73.04 points on average. The level of digital competitiveness of underdeveloped countries is critically low – 49.29 points on average. The statistical data for regression analysis on the selected objects are given in Table 1.

*AI – artificial intelligence.

Figure 2. A logical scheme of the research, which reflects the working hypothesis (H_0).
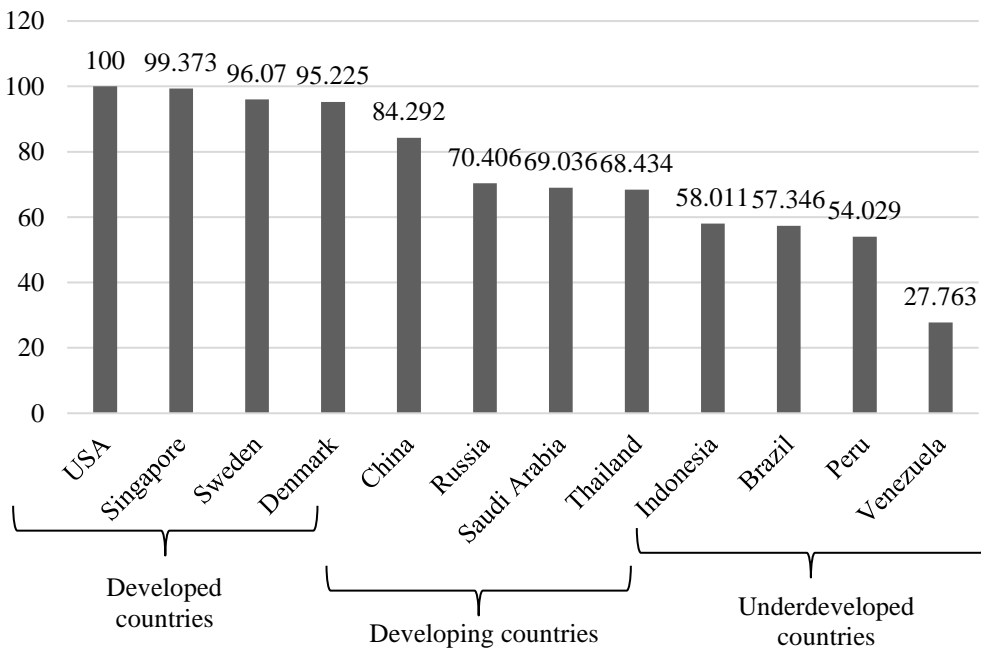Source: developed and compiled by the authors

Figure 3. Statistics of digital competitiveness in countries of the distinguished categories in 2020, points 1-100.
Source: built by the authors based on IMD (2020)

Table 1. Statistics of management of innovative projects and strategic results for quality in countries with developed digital economy in 2020.

Category of countries	Country	Quality management during the implementation of innovative projects in entrepreneurship					Results of innovative projects for quality		
-	-	Attitudes towards entrepreneurial risk	Willingness to delegate authority	Companies embracing disruptive ideas	Reliance on professional management	Pay and productivity	World robots distribution	Use of big data and analytics	High-tech exports
		x_1	x_2	x_3	x_4	x_5	y_1	y_2	y_3
Developed countries	USA	75.9	77.0	68.1	78.9	71.1	4	6	20
	Singapore	58.9	72.2	59.6	83.5	74.6	15	15	2
	Sweden	67.5	81.9	59.6	80.7	58.9	17	7	25
	Denmark	57.7	82.4	64.5	82.1	65.1	30	17	33
Developing countries	China	58.4	58.5	53.8	59.0	60.5	1	12	6
	Russia	52.7	55.6	44.0	49.6	58.9	34	31	34
	Saudi Arabia	58.3	64.3	54.0	64.0	65.9	52	22	59
	Thailand	58.1	58.9	51.7	58.4	60.1	10	37	9
Underdeveloped countries	Indonesia	58.4	65,5	55.5	61.7	60.4	25	8	54
	Brazil	51.1	56.7	46.8	58.6	40.4	19	60	30
	Peru	50.6	50.3	39.0	52.1	42.1	54	59	57
	Venezuela	50.9	50.5	49.3	53.1	19.4	57	44	63

*AI – artificial intelligence.
Source: compiled by the authors based on IMD (2020), World Economic Forum (2020)

In the second part of this work, simplex method and comparative analysis are used for determining the approaches to quality management during the implementation of innovative projects and comparing them from the positions of the contribution to strategic development of a company. In the third part, systemic analysis is used for substantiating the optimal – risk-oriented – approach, which ensures the highest effectiveness of quality management during the implementation of innovative projects for company's strategic development.

4. Results

4.1. Analysis of dependence of the consequences for quality (effectiveness) on management of innovative projects in entrepreneurship

For determining the dependence of the consequences for quality (effectiveness) on management of innovative projects in entrepreneurship in countries with developed digital economy in 2020, we use the results of regression analysis that are obtained based

on the data from Table 1 (Table 2).

The results of the regression analysis (Table 2) show that management of business risks has a positive (negative regression with all components of quality) but isolated (regression above 1 in the absolute value only with 1 of 3 components of quality) influence on quality of products in entrepreneurship. Improvement of the practice of business risks management by 1 points leads to improvement of robotization by 1.04 positions, use of AI and Big data – by 0.22 positions, and hi-tech export – by 0.56 positions.

Table 2. Results of regression analysis

Indicator	Symbol	Robotization	Use of AI* and Big data	Hi-tech export
		y1	y2	y3
Constant		108.59	135.79	86.86
Managing business risks	Coefficient with x_1	-1.04	-0.22	-0.56
Delegating authorities and responsibility	Coefficient with x_2	0.88	-0.79	2.02
Supporting breakthrough ideas	Coefficient with x_3	-0.66	-1.66	0.01
Professionalism of management	Coefficient with x_4	-0.22	1.06	-1.67
Stimulation of labor efficiency	Coefficient with x_5	-0.50	-0.45	-0.77
Coefficient of multiple determination	Multiple R	0.6651	0.8907	0.6566

*AI – artificial intelligence.
Source: calculated and compiled by the authors.

Delegation of authorities and responsibility has negative (negative regression only with one resulting variable) and isolated (regression above 1 in absolute value only with 1 of 3 components of quality) influence on quality of products in entrepreneurship. Increase of development of delegation of authorities and responsibility by 1 point leads to aggravation of robotization by 0.88 positions, improvement of use of AI and Big data by 0.79 positions, and aggravation of hi-tech export by 2.02 positions.

Support for breakthrough ideas has positive (negative regression with two components of quality out of three components) but isolated (regression above 1 in absolute value with only 1 of 3 components of quality) influence on quality of products in entrepreneurship. Increase of support for breakthrough ideas by 1 point leads to improvement of robotization by 0.66 positions, improvement of AI and Big data by 1.66 positions, and

aggravation of hi-tech export by 0.01 positions (almost zero connection).

Professionalism of management has positive (negative regression with two components of quality out of three) and systemic (regression above 1 in absolute value with 2 out of 3 components of quality) influence on quality of products in entrepreneurship. Increase of professionalism of management by 1 point leads to improvement of robotization by 0.22 positions, aggravation of use of AI and Big data by 1.06 positions, and improvement of hi-tech export by 1.67 positions.

Stimulation of labor efficiency has positive (negative regression with all components of quality) but isolated and weak (regression above 1 in absolute value is absent) influence on quality of products in entrepreneurship. Improvement of the practice of business risks management by 1 point leads to improvement of robotization by 0.50 positions, use of AI and Big data –

by 0.45 positions, and hi-tech export – by 0.77 positions.

Multiple R=0.6651 (below 0.9) in the robotization function shows a vivid but moderate correlation (connection) between indicators. Multiple R=0.8907 (below 0.9) in the function of use of AI and Big data shows strong correlation (connection) between the indicators. Multiple R=0.6566 (below 0.9) in the function of hi-tech export shows a vivid but moderate correlation (connection) between the indicators.

Thus, effectiveness of quality management of products during the implementation of innovative projects in entrepreneurship is moderate in countries with developed digital economy. Thus, there are perspectives of increase of quality management's effectiveness.

4.2. Determining the approaches to quality management during the implementation of innovative projects and comparing them from the positions of the contribution to strategic development of a company

The following approaches to quality management during the implementation of innovative projects in the period until 2024 are determined:

- 1st approach: robotization. It envisages double increase of the average level of robotization in countries with developed digital economy – i.e., y_1 has to reach 13,25 position (26.50/2);
- 2nd approach: intellectualization. It is connected to double increase of the average level of use of AI and Big data in countries with developed digital economy – i.e., y_2 has to reach 13.25 position (26.50/2);
- 3rd approach: hi-tech character. It is oriented at double increase of the average level of hi-tech character in

countries with developed digital economy – i.e., y_3 has to reach 16.33 position (32.67/2);

- 4th position: systemic optimization. It has to balance the advantages for all components of products' quality and ensure the systemic effectiveness of innovative projects' management in entrepreneurship from the positions of strategic development – i.e., y_1 has to be at least 13.25, y_2 – at least 13.25, and y_3 – at least 16.33.

Quantitative parameters of the approaches to quality management during the implementation of innovative projects and their comparison from the positions of the contribution to strategic development of a company are shown in Table 3.

As shown in Table 3, strategic growth of all y during the first approach (robotization) is -38.60 positions, during the second approach (intellectualization) -41.58 positions, and during the third approach -50.73 positions. The largest average growth of all y is achieved during the 4th approach (systemic optimization), it equals -71.52 positions. That's why the 4th approach is most preferable from the positions of company's strategic development based on the increase of uniqueness of its products' quality in the conditions of the digital economy.

4.3. Substantiation of the optimal – risk-oriented – approach, which provides the highest effectiveness of quality management during the implementation of innovative projects for company's strategic development

Quantitative characteristics of a risk-oriented approach to quality management during the implementation of innovative projects for strategic development of a company according to the results obtained in Table 3 are shown in Figure 4.

Table 3. Quantitative parameters of the approaches to quality management during the implementation of innovative projects.

| Variable | Initial value: average in 2020 | 1st approach: robotization | | 2nd approach: intellectualization | | 3rd approach: hi-tech character | | 4th approach: systemic optimization | |
| | | Goal: y_1=13.25 | | Goal: y_2=13.25 | | Goal: y_3=16.33 | | Goal: y_1=13.25 with y_2=13.25 with y_3=16.33 | |
		Target value in 2024	Growth in 2024 %	Target value in 2024	Growth in 2024, %	Target value in 2024	Growth in 2024, %	Target value in 2024	Growth in 2024, %
x_1	58.21	66.79	14.74	65.96	13.32	67.12	15.31	70.00	20.26
x_2	64.48	64.48	-0.01	65.09	0.94	64.48	-0.01	64.48	-0.01
x_3	53.83	58.63	8.93	59.91	11.31	59.89	11.27	60.00	11.47
x_4	65.14	66.77	2.50	65.94	1.23	69.38	6.51	70.00	7.46
x_5	56.45	60.09	6.45	60.44	7.07	62.03	9.88	69.00	22.23
y_1	26.50	13.25	-50.00	12.77	-51.81	9.48	-64.23	2.77	-89.55
y_2	26.50	16.96	-36.00	13.25	-50.00	16.44	-37.96	13.15	-50.38
y_3	32.67	22.93	-29.81	25.18	-22.92	16.33	-50.01	8.29	-74.62
Average growth of all y: contribution to strategic development*		-38.60	-	-41.58	-	-50.73	-	-71.52	

*the lower the number the better, for y_1,y_2,y_3 are measured in positions.
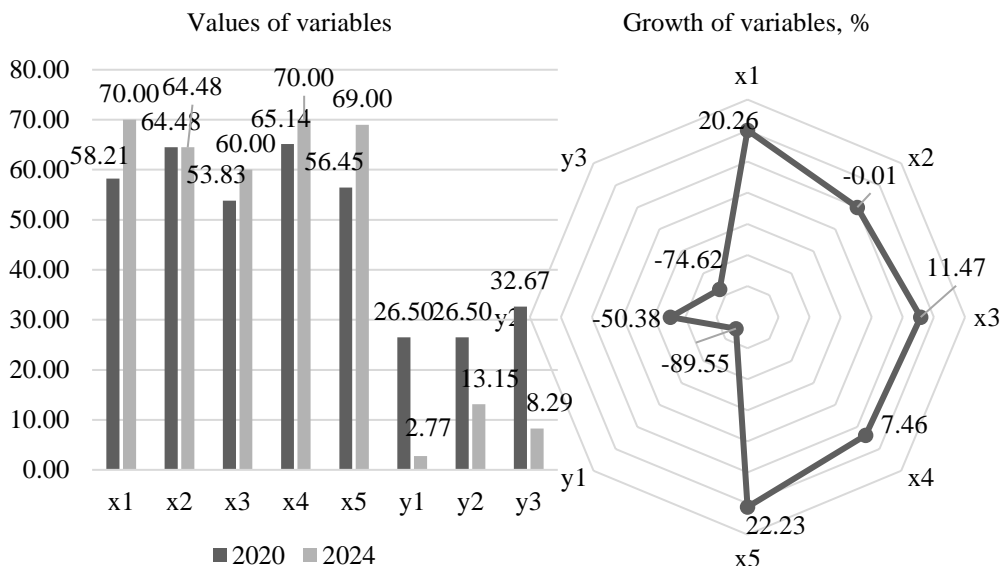
Source: calculated and compiled by the authors

Figure 4. Quantitative characteristics of a risk-oriented approach to quality management during the implementation of innovative projects for strategic development of a company

Source: calculated and compiled by the authors

As shown in Figure 4, a risk-oriented approach to quality management during the implementation of innovative projects for company's strategic development envisages, firstly, the increase of effectiveness of stimulating labor efficiency (x_5) from 56.45 points in 2020 to 69 points in 2024 – i.e., by 22.23%. For this, it is recommended to orient employees from increase of the production volume to transition to more progressive technologies.

In countries with developing digital economy, this envisages the transition from manual labor to machine labor or from mechanized labor to automatized labor based on digital technologies. In countries with developed digital economy, transition from simple digital technologies (e.g., Internet and cloud technologies) to more complex technologies of Industry 4.0 (e.g., the Internet of Things, Big data, AI, and robots) is expedient.

Secondly, increase of effectiveness of business risks management (x_1) from 58.21 points in 2020 to 70 points in 2024 – i.e., by 20.26%. For this, it is recommended to implement risk management of an improved classification of risks into corporate practices, within which risks that are connected to low-tech innovations decrease and risks that are connected to hi-tech innovations are accepted by the company. Due to this, a company's innovations become more oriented at hi-tech and digital modernization, and a general reduction of the level of the entrepreneurial activities' risk is achieved.

Thirdly, increase of effectiveness of support for breakthrough ideas (x_3) from 53.83 points in 2020 to 60 points in 2024 – i.e., by 11.47%. For this, it is recommended to stimulate company's employees not only for execution of the management's orders on implementing ready innovations but also for independent promotion of innovative ideas. It is also expedient to form innovative teams at a company – which will conduct R&D and implement the results in business processes.

Fourthly, increase of management's professionalism (x_4) from 65.14 points in 2020 to 70 points in 2024 – i.e., by 7.46%. For this, it is recommended to raise the level of digital literacy of the company's managers by means of self-education (life-long learning) and by means of corporate training. Development of the practice of delegation of authorities and responsibility (x_2) is not required, as it has no large influence on strategic management of products' quality in the process of a company's innovative activities.

6. Conclusion

Thus, the offered hypothesis (H_0) has been disproved. Based on the developed proprietary scale for classifying the levels and qualitative treatment of effectiveness of quality management during the implementation of innovative projects for company's strategic development and with the help of regression analysis, it has been proved that in countries with developed market economy the effectiveness of quality management during the implementation of innovative projects from the positions of company's strategic development is moderate (not high) and thus requires an increase.

The most probable reason of this problem is contradiction, which consists in the following: on the one hand, the digital market environment has already formed, so the leading technologies and hi-tech innovations are widely accessible. On the other hand, modernization of management is delayed. Companies' managers preserve the traditional orientation at low-tech innovations, which are either a goal in itself (company's innovativeness as a condition of its competitiveness) or as a means of increasing competitiveness by means of reduction of price or short-term increase of quality (copied, unsustainable competitive advantages). This contradiction creates high risks for strategic quality of products in the process of a company's innovative activities.

The solution to this problem might lie in reorientation of companies' managers in in countries with developed digital economy at hi-tech innovations, which allow forming sustainable competitive advantages and provide business's strategic competitiveness. For this, a risk- oriented approach to quality management during the implementation of innovative projects for company's strategic development is recommended.

This approach ensures the increase of effectiveness of quality management of a company in the process of its innovative activities by means of stimulation of labor efficiency from the positions of hi-tech character, management of business risks (adoption of only hi-tech risks), support for breakthrough ideas, and increase of management's digital competence. Due to the authors' recommendations, formed on the basis of the mathematical tools and accompanied by precise quantitative calculations based on econometrics, the following advantages in countries with developed digital economy for quality will be achieved by means of innovations by 2024:

- Increase of robotization - from 26.50 position in 2020 to 2.77 position, i.e., by 89.55%;
- Growth of activity of using AI and Big data – from 26.50 position in 2020 to 13.15 position in 2024, i.e., by 50.38%;
- Increase of hi-tech export – from 32.67 position in 2020 to 8.29 position in 2024, i.e., by 74.62%.

The performed research shows detailed perspectives of increase of effectiveness of quality management during the implementation of innovative projects for strategic development of entrepreneurship in countries with developed digital economy. Due to the absence of official statistics, required for provision of the scientific basis of the research, countries with developing digital economy remained beyond the scope of the study. The study of experience, substantiation of perspectives, and development of recommendations for quality management during the implementation of innovative projects for strategic development of entrepreneurship determine the perspectives of future scientific works in continuation of the performed research.

References:

Ali, G. A., Hilman, H., & Gorondutse, A. H. (2020). Effect of entrepreneurial orientation, market orientation and total quality management on performance: Evidence from Saudi SMEs. *Benchmarking: An International Journal, 27*(4), 1503-1531. https://doi.org/10.1108/BIJ-08-2019-0391

Ali, M. C. (2014). Exploring the potential of integration quality assessment system in construction (qlassic) with iso 9001 quality management system (qms). *International Journal for Quality Research, 8*(1), 73-86.

Alpidovskaya, M. L., & Popkova, E. G. (2019). Marx & Modernity: A Political & Economic Analysis of Social Systems Management. A volume in the series Popkova, E.G. (Ed.) *Advances in Research on Russian Business & Management*; Charlotte, NC, USA: Information Age Publishing.

Bacoup, P., Michel, C., Habchi, G., & Pralus, M. (2018). From a Quality Management System (QMS) to a Lean Quality Management System (LQMS). *The TQM Journal, 30*(1), 20-42. https://doi.org/10.1108/TQM-06-2016-0053

Conti, E., Vesci, M., Crudele, C., & Pencarelli, T. (2019). Design-driven innovation, quality, and customer value in manufacturing companies. *The TQM Journal, 31*(6), 968-986. https://doi.org/10.1108/TQM-01-2019-0032

Franz, B. (2018). Total Construction Management: Lean Quality in Construction Project Delivery. Engineering, *Construction & Architectural Management, 25*(2), 295-296. https://doi.org/10.1108/ECAM-12-2017-0268

Garza-Reyes, J. A. (2018). A systematic approach to diagnose the current status of quality management systems & business processes. *Business Process Management Journal, 24*(1), 216-233. https://doi.org/10.1108/BPMJ-12-2016-0248

Hosseinzadeh, F., Paryzad, B., Pour, N. S., & Najafi, E. (2020). Fuzzy combinatorial optimization in four-dimensional tradeoff problem of cost-time-quality-risk in one dimension & in the second dimension of risk context in ambiguous mode. *Engineering Computations, 37*(6), 1967-1991. https://doi.org/10.1108/EC-03-2019-0094

Hussain, M., Khan, M., Ajmal, M., & Ahmad Khan, B. (2019). Supply chain quality management & organizational performance: Empirical evidence from telecom industry in the UAE. *Benchmarking: An International Journal, 27*(1), 232-249. https://doi.org/10.1108/BIJ-07-2018-0196

IMD (2020). *World Digital Competitiveness Ranking 2019*. Retrieved from: https://www.imd.org/wcc/world-competitiveness-center-rankings/world-digital-competitiveness-rankings-2019/ (27.07.2020).

Inshakova, A. O., & Bogoviz, A. V. (Ed.) (2020). *Alternative Methods of Judging Economic Conflicts in the National Positive & Soft Law*. A volume in the series Popkova, E.G. (Ed.) Advances in Research on Russian Business & Management, Charlotte, NC, USA, Information Age Publishing.

Kaur, M., Singh, K., & Singh, D. (2019). Synergetic success factors of total quality management (TQM) & supply chain management (SCM): A literature review. International *Journal of Quality & Reliability Management, 36*(6), 842-863. https://doi.org/10.1108/IJQRM-11-2017-0228

Khesal, T., Saghaei, A., Khalilzadeh, M., Rahiminezhad Galankashi, M., & Soltani, R. (2019). Integrated cost, quality, risk & schedule control through earned value management (EVM). *Journal of Engineering, Design & Technology, 17*(1), 183-203. https://doi.org/10.1108/JEDT-07-2018-0119

Kucuk Yilmaz, A. (2019). Transformation process risk management to sustainable corporate performance & quality management: developing flowcharts for approved training organization. *Aircraft Engineering & Aerospace Technology, 92*(2), 201-212. https://doi.org/10.1108/AEAT-07-2019-0151

Mahmoudi, A., & Feylizadeh, M. R. (2018). A grey mathematical model for crashing of projects by considering time, cost, quality, risk & law of diminishing returns. *Grey Systems: Theory & Application, 8*(3), 272-294. https://doi.org/10.1108/GS-12-2017-0042

Mazzuto, G., & Ciarapica, F. E. (2019). A big data analytics approach to quality, reliability & risk management. *International Journal of Quality & Reliability Management, 36*(1), 2-6. https://doi.org/10.1108/IJQRM-01-2019-294

Moschidis, O., Chatzipetrou, E., & Tsiotras, G. (2018). Quality costing & quality management maturity in Greece: An exploratory multi-dimensional data analysis. *International Journal of Productivity & Performance Management, 67*(1), 171-191. https://doi.org/10.1108/IJPPM-08-2016-0152

Phan, A. C., Nguyen, H. A., Trieu, P. D., Nguyen, H. T., & Matsui, Y. (2019). Impact of supply chain quality management practices on operational performance: empirical evidence from manufacturing companies in Vietnam. *Supply Chain Management, 24*(6), 855-871. https://doi.org/10.1108/SCM-12-2018-0445

Popkova, E. G. (2017). Economic & Legal Foundations of Modern Russian Society. A volume in the series Popkova, E.G. (Ed.) *Advances in Research on Russian Business & Management.* Charlotte, NC, USA: Information Age Publishing.

Popkova, E. G. (2019). Preconditions of formation & development of industry 4.0 in the conditions of knowledge economy. *Studies in Systems, Decision & Control, 169*(1), 65-72.

Popkova, E. G. (2020). A new treatment of quality of goods & services in the conditions of the knowledge economy: opposition of traditions & innovations. *International Journal for Quality Research, 14*(2), 329-346. https://doi.org/10.24874/IJQR14.02-01.

Popkova, E. G., Przhedetsky, Yu V., Przhedetskaya, N. V. & Borzenko, K. V. (Ed.) (2020). Marketing of Healthcare Organizations: Technologies of Public-Private Partnership. A volume in the series Popkova, E.G. (Ed.) *Advances in Research on Russian Business & Management*. Charlotte, NC, USA: Information Age Publishing.

Popkova, E. G., & Sergi, B. S. (2020). Human Capital & AI in Industry 4.0. Convergence & Divergence in Social Entrepreneurship in Russia. *Journal of Intellectual Capital.* https://doi.org/10.1108/JIC-09-2019-0224.

Popkova, E. G., Poluyufta, L., Beshanova, Y., Popova, L. V., & Kolesnikova, E. (2017). Innovations as a basis for marketing strategies of Russian oil companies in the conditions of oil prices reduction. *Contributions to Economics,* (9783319606958), 449-455. https://doi.org/10.1007/978-3-319-60696-5_57

Popkova, E. G., & Sergi, B. S. (2018). Will Industry 4.0 & Other Innovations Impact Russia's Development? In Bruno S. Sergi (Ed.) *Exploring the Future of Russia's Economy & Markets: Towards Sustainable Economic Development* (pp. 51-68). Bingley, UK: Emerald Publishing Limited.

Popkova, E. G., & Sergi, B. S. (Eds.) (2019). *Digital Economy: Complexity & Variety vs. Rationality*. Berlin, Springer International Publishing.

Ragulina, Y. V. (2019). Priorities of development of industry 4.0 in modern economic systems with different progress in formation of knowledge economy. *Studies in Systems, Decision & Control, 169*, 167-174.

Rosillo-Díaz, E., Blanco-Encomienda, F. J., & Crespo-Almendros, E. (2019). A cross-cultural analysis of perceived product quality, perceived risk & purchase intention in e-commerce platforms. *Journal of Enterprise Information Management, 33*(1),139-160. https://doi.org/10.1108/JEIM-06-2019-0150

Ruiz, E., de Pablo, J.D.S., Muñoz, R.M.M. & Peña, I. (2019). Do high performance work systems enhance business performance? *Proceedings of Rijeka Faculty of Economics: Journal of Economics and Business, 37*(1), 235-258. https://doi.org/10.18045/zbefri.2019.1.235

Santos, G., Gomes, S., Braga, V., Braga, A., Lima, V., Teixeira, P., & Sá, J. C. (2019). Value creation through quality & innovation – a case study on Portugal. *The TQM Journal, 31*(6), 928-947. https://doi.org/10.1108/TQM-12-2018-0223

Schniederjans, D. G. (2018). Business process innovation on quality & supply chains. *Business Process Management Journal, 24*(3), 635-651. https://doi.org/10.1108/BPMJ-04-2016-0088

Sedevich-Fons, L. (2018). Linking strategic management accounting & quality management systems. *Business Process Management Journal, 24*(6), 1302-1320. https://doi.org/10.1108/BPMJ-02-2018-0038

Shahin, A. (2019). Quality & innovation: how to create value for customers by value-added innovation. *The TQM Journal, 31*(6), 873-873. https://doi.org/10.1108/TQM-11-2019-233

Shulus, A. A., Akopova, E. S., Przhedetskaya, N. V., & Borzenko, K. V. (2020). Intellectual Production & Consumption: A New Reality of the 21st Century. *Lecture Notes in Networks & Systems, 92*, 353-359.

Simat, K., Blešić, I., Božić, S., Avramović, M., & Ivkov, M. (2018). Customer orientation of employees in travel agencies as a predisposition of service quality: test of cose consequences model. *International Journal for Quality Research, 8*(1) 61-72. https://doi.org/10.18421/IJQR12.04-05.

Srinivas, R., & Swamy, D. R. (2013). Quality management practices in rural & urban SMEs – a comparative study. *International Journal for Quality Research, 7*(4) 479-492.

Stolyarov, N. O., Petrenko, E. S., Serova, O. A., & Umuralieva, A. S. (2020). The Digital Reality of the Modern Economy: New Actors and New Decision-Making Logic. *Lecture Notes in Networks & Systems, 87*, 882-888.

Sumardi, S., & Fern&es, A. A. R. (2020). The influence of quality management on organization performance: service quality and product characteristics as a medium. *Property Management, 38*(3), 383-403. https://doi.org/10.1108/PM-10-2019-0060

Tortorella, G., Giglio, R., Fogliatto, F. S., & Sawhney, R. (2019). Mediating role of learning organization on the relationship between total quality management & operational performance in Brazilian manufacturers. *Journal of Manufacturing Technology Management, 31*(3), 524-541. https://doi.org/10.1108/JMTM-05-2019-0200

Uluskan, M., McCreery, J. K., & Rothenberg, L. (2018). Impact of quality management practices on change readiness due to new quality implementations. *International Journal of Lean Six Sigma, 9*(3), 351-373. https://doi.org/10.1108/IJLSS-05-2017-0049

World Economic Forum (2020). *The Global Competitiveness Report 2019*. Retrieved from: https://www.weforum.org/reports/how-to-end-a-decade-of-lost-productivity-growth (27.07.2020).

Mariya V. Mazunina
Krasnodar Branch of Financial University under the Government of the Russian Federation, Russian Federation
MVMazunina@fa.ru

Aleksandr G. Rubin
Krasnodar Branch of Financial University under the Government of the Russian Federation, Russian Federation
AGRubin@fa.ru

Natalia V. Zinchenko
Krasnodar Branch of Financial University under the Government of the Russian Federation, Russian Federation
NaVZinchenko@fa.ru

Natalia N. Gribok
Krasnodar Branch of Financial University under the Government of the Russian Federation, Russian Federation
NNGribok@fa.ru

Marina A. Vorobyova
Krasnodar Branch of Financial University under the Government of the Russian Federation, Russian Federation
MAVorobeva@fa.ru