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## PRODUCT QUALITY MANAGEMENT WITH THE HELP OF INNOVATIONS: METHODOLOGICAL RECOMMENDATIONS FOR DECISION-MAKING

**Abstract:** *This work strived to solve an important scientific problem of developing methodological recommendations on decision-making in the sphere of product quality management with the help of innovations. According to this, the paper generalised and supplemented the methodological provisions of the theory of managerial decision-making given the specifics of the processes of quality management and the use of innovations and characterised the influence and value of new ideas and solutions on the quality of products and the general effectiveness and competitiveness of the company.*

*The paper also substantiated the important role of innovations from the position of their influence on the quality of products and considered the system of quality management based on innovations, which includes technical and social components, in particular, the cycle of innovations of quality, tools and methodology of ensuring quality, on the one hand, and the principles of quality management and culture of quality and learning, on the other hand. Special attention was paid to the necessity to take into account – when developing managerial decisions – the complex economic and market proportions through modelling of the appropriate strategies based on game theory methods. This allows considering not only the factual parameters of price, quality, and expenses but also modelling their influence on the general market situation, including the behaviour of rivals and consumers.*

**Keywords:** *quality, system of quality management, innovations, managerial decisions, managerial decision-making.*

### 1. Introduction

In the conditions of aggressive competitive struggle, improvement of quality and quality and support for innovations are mandatory demands for the system of management. They determine competitive advantages and

allow companies to reach success. Serious challenges faced by modern companies drive them towards the search for better innovative methods in all aspects that are connected with product quality, competitive struggle, development, and achievement of goals in profitability and effectiveness. Innovations

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are often the key to reaching such goals (Crv, 2023).

Additional pressure on companies comes from the process of constant complication of products and services, reduction of the duration of the product life cycle, and the influence of different social groups with the introduction of demands, which is not peculiar to the main profile of activities (Nguyen Minh Tri 2023).. This requires the constant search for good solutions in the sphere of quality support and achievement of success (Rauter et al., 2018). Demands for companies, which strive towards long-term success in the conditions of the strict competitive environment, include innovativeness and adaptability (Lilja et al., 2017). It is necessary to change and be in the context of change, as well as offer quality changes through innovations.

Thus, in a dynamic, tough, and competitive environment, innovations and quality management are the key factors for ensuring competitive advantages. The current results of the research show that innovations help in the formation of unique products, as well as an increase in their value for consumers (Zeng et al., 2015). Together with this, they are a factor in technological progress, which determines vectors of socioeconomic systems' development, including transition to new technological modes. At present, the task of improvement of product quality due to innovations is largely achieved within the concept of Industry 4.0, which is accompanied by the wide use of such tools as artificial intelligence, the Internet of Things, Big Data, robots 3D print, etc. Such a situation leads to the need for more thorough research of the means of combining the above tools within complex systems of quality management with a special emphasis on managerial decision-making.

Despite the high potential of innovations in the sphere of improvement of product quality, decision-making on their use is closely connected with many risks and

influences and has many alternatives. In this context, assessment of the expedience of using innovations to achieve goals in quality is aimed at determining advantages and disadvantages, comparison of expenditures and incomes that are formed due to innovations, and coordination of alternative expenses for the most rational distribution of resources. Thus, the generalisation and expansion of methodological recommendations on decision-making in the use of innovations for product quality management form an important scientific and practical problem. Its resolution will allow raising the general level of innovativeness, effectiveness, and competitiveness of the company.

## **2. Methodological basis of the research**

The theoretical basis of the study of the problems of decision-making in the sphere of using innovations for the improvement of product quality has a complex multidisciplinary nature. It is manifested through methodological approaches of the theories of general management, development, managerial decision-making, innovative management, and quality management, which are set onto complex technological and economic processes. In aggregate, they form a comprehensive system, within which the achievement of goals on an increase in product quality takes place as a result of complex socioeconomic interactions, aimed at ensuring the economic interest of all involved parties.

Application of the above approaches and methodological foundations within this research allows for the agreement of different directions, which often seek different goals. Their isolated resolution does not provide correct results. Such directions are the problems of product quality management, management of innovations and the theory of managerial decision-making. Each of these directions has the potential for comprehensive coverage

and readjustment of the management system. However, while the theory of decision-making is largely a technical tool, quality management and innovations have a clear conceptual basis. In the first case, emphasis is made on ensuring better correspondence between the parameters of products and the expectations/demands of the market. In the other case, the main attention is paid to innovations, their return, and their influence on the key indicators of companies: effectiveness, competitiveness, etc. At that, decision-making performs the role of a tool to justify decisions on quality and innovations. The sense of decisions in this case involves the selection of the most optimal directions for activities at each stage of the company's development.

Thus, the theory of managerial decision-making requires clear methodological provisions, which would allow for a rational choice in the conditions of limited information, complexity and uncertainty of the environment, dynamic change in conditions, and strict limitations on resources, time, and possibilities. In such conditions, agreement of innovative processes with the tasks of quality management can ensure more alternatives, lift some limitations, and create conditions for constant improvement of the quality system.

The definition of quality in modern scientific literature is often treated given the determination of the correspondence of the parameters of product quality to market demands. The connection of quality with the market is an objective condition, which, at the same time, forms the main methodological criteria: changeability, uncertainty, and competitiveness. These parameters are decisive during the formation of market demands, which are manifested through demand, expectation, and competitive alternatives. Identification of "demands" in this context is the key task. Its resolution allows designing results of these market demands for the production system and work on their resolution. Another

component is managerial and technological conditions, which allow adjusting the production system for the necessary parameters and keeping it in its current state. In aggregate, achievement of the above results takes place within the systems of quality management, which combine all tasks on the identification of needs, their design in the production system, and ensuring the necessary result.

Product quality management is a multifactor phenomenon and complex process, which can be manifested through network models and systems. Simplified forms of such models contain certain formalisation of conditions or factors that influence product quality management. One of the options for such formalisation is the division of quality management into social and technical management (Schniederjans & Schniederjans, 2015). Social quality management is implemented through behavioural and organisational processes in the form of training, cooperation, administering, stimulation, etc. Technical quality management takes place through mechanical tools and techniques, which focus on measurement and monitoring, support for properties of quality and their control.

Given the essence and character of tasks on the development, substantiation, and managerial decision-making in complex socioeconomic models, the choice of a rational methodological basis is one of the main tasks that define the results. In this context, the most complex methodological apparatus is the one of the theory of research optimisation and research, in particular, imitation modelling, methods of multicriterial optimisation, expert methods, etc. Besides, a large potential for solving the problem of substantiation of managerial decisions in the context of product quality management due to innovations is found with game theory, which can belong, at the same time, to the methods of operations research and behavioural economics.

The advantages of using the methodological apparatus of game theory within the above problematics consist in the possibility of processing information on a large number of interested parties that have different interests, offering courses of action to solve the conflict of interests, determining strategies that manage the actions of each player, and selecting the most rational solution given the actions of other players.

The theoretical basis of the research consists of multiple works devoted to one or several mentioned problems, which are connected with description of the influence of social and technological innovations on production processes and effectiveness (Abdallah et al., 2021; Bhadu et al., 2022); management of the quality of operations sustainability (Crv, 2023); role of knowledge in innovations management (Dmytrenko & Prokop, 2023); the use of managerial means in the process of development and implementation of innovations (Fanti & Gori, 2023); connection between the system of quality management, innovations, and production indicators (Feng et al., 2006; Zeng et al., 2015); potential of value chain in the system of quality management and innovations (Kafel et al., 2023); coverage of the capabilities of Industry 4.0 (Kovačić, 2023; Müller, 2019; Prashar, 2023; Sader et al., 2019; Sozinova et al., 2023) and Quality 4.0 (Virmani et al., 2023) in the studied processes; decisive influence of innovations on the system of quality management of the company (Lilja et al., 2017; Quality management, 2024; Schniederjans & Schniederjans, 2015); adaptation of the tools of the theory of decision-making to the demands of the system of quality management and innovative development (Noronha et al., 2023).

The goal of this paper was to generalise and substantiate methodological recommendations on decision-making, which concerns the management of the quality of products with the help of innovations. Within the achievement of this goal, a range of other tasks was solved:

determining the essence and specifics of the key definitions of managerial decisions, management of quality and innovations, research and generalisation of the problems and factors of decision-making in the described conditions, and development of methodological recommendations on managerial decision-making with the emphasis on quality and innovations in dynamic market conditions.

### **3. Experimental setting and methods**

The general theory of management considers the process of managerial decision-making as a sequence of certain stages, which include the following: diagnostic of the problem, determination of the goal and criteria of assessment of the solution, development of alternatives, assessment and selection of the optimal alternative, and implementation of solutions in practical activities. Such a sequence is rather universal. It can be applied almost to all managerial situations and problems. However, from the position of each specific situation, it can be supplemented or specified. Thus, quality management predetermines the necessity of expanding the criteria with parameters aimed at market demands. In turn, the use of innovations requires the resolution of the task on the expedience of their use from the position of availability of a possible alternative. Additional supplements and clarifications could be used at the stages of collection of information about the problem, development of alternatives, implementation of solutions to practical activities, etc.

From the position of quality management, innovative factors are resources and tools for eliminating problems with quality or supporting its increase. They are manifested through the strategy of the company, its resource provision, organisational culture, and the level of integration of innovative policy into the system of management at all levels (Dmytrenko & Prokop, 2023). Some

of the above factors, elements, and tools form the internal environment of the company, while the other part is formed by external factors: patents, inventions, general scientific and technical environment, system of production, protection, expansion of knowledge, etc. An important task of management, according to this, is agreement of internal and external processes, which is achieved due to the systems approach.

The methodological basis points to the existence of an entire range of assumptions and hypotheses, which influence the methodological provisions of decision-making in the sphere of innovations and quality management. In this context, each parameter of management could be viewed as a favourable, negative, or neutral factor. Thus, the level of centralisation and decentralisation of management influences the character of decision-making and the possibility of using external knowledge for the development of innovations (Dmytrenko & Prokop, 2023). Apart from this, the development of effective interrelations, as one of the principles of quality management (ISO, 2015), distinguishes the innovative and quality potential of cooperation with other participants of the market.

Special attention in this context should be paid to the supply chain. This is connected with the sequence and agreement of production processes and their mutual dependence. High-quality resource provisions significantly raise the opportunities for the achievement of high-quality final products. The same influence is implemented within the stages of internal movement, preparation for production, storing, etc. (Kafel et al., 2023). Thus, decision-making on the use of innovations for quality management cannot be viewed separately from other connected processes of the supply chain (Kovačić, 2023).

The tools for quality improvement are actively manifested in Industry 4.0. A systemic vision, which involves the interaction of digital technologies, industrial

production processes, and quality management, is realised most fully through the concept of Quality 4.0. (Virmani et al., 2023). Apart from the direct effect, connected with the combination of effective tools of innovations and quality, such an approach improves managerial processes, together with the process of managerial decision-making, an increase in the effectiveness of processes, coordination of the activities of the supply chain elements, and support for constant improvement. At that, the Lean approach allows tracking processes or tasks connected with planning and optimisation (Müller, 2019).

At present, the elements of digital technologies are viewed as the main factors of innovations, which allow going beyond the traditional markets and forming new opportunities. In this context, Industry 4.0 is a factor of innovative changes and, at the same time, an environment within which technological shifts, new visions, approaches, etc. take place (Prashar, 2023; Sader et al., 2019).

Understanding of innovations, formed by J. Schumpeter, points to the fact that evolution has a cyclical character due to the network effect, in which one entrepreneur, implementing a new product, forms, at the same time, the possibility for innovations of other entrepreneurs (Schumpeter and Nichol, 1934). Current networks allow the multiplication of innovations within global production and information interconnections, increasing the impact of novel inventions on economic and related processes. Supplementing this network with criteria of quality forms a new vision, which can accelerate and improve production processes. In such conditions, basic innovations, which are the foundation for further developments, conform to market demands in a better way, have a lower level of rejections, and raise the general level of technological and economic development.

In such conditions, quality demands acquire a global universal character. New

technologies are quickly spreading and becoming accessible. Most of them lose their novelty and advantages also very quickly. Thus, it is important to ensure a quick cycle of development and implementation of innovations, to achieve quick returns on them (Sozinova et al., 2023).

Without denying the important impact of digital technologies on innovations and quality, it should be noted that each invention and its implementation are always treated only as one (or several) of a large number of alternatives. The existence of other courses of action, including alternative (non-digital) factors of ensuring innovations, or resolution of problems with quality without the use of innovative technologies, form an important condition, which demands additional research and substantiation. That is why, generalisation and interpretation of approaches to decision-making, which are connected with innovations and quality management, is an important factor in raising the level of justification of managerial decisions in the sphere of more active use of innovations in the sphere of quality management.

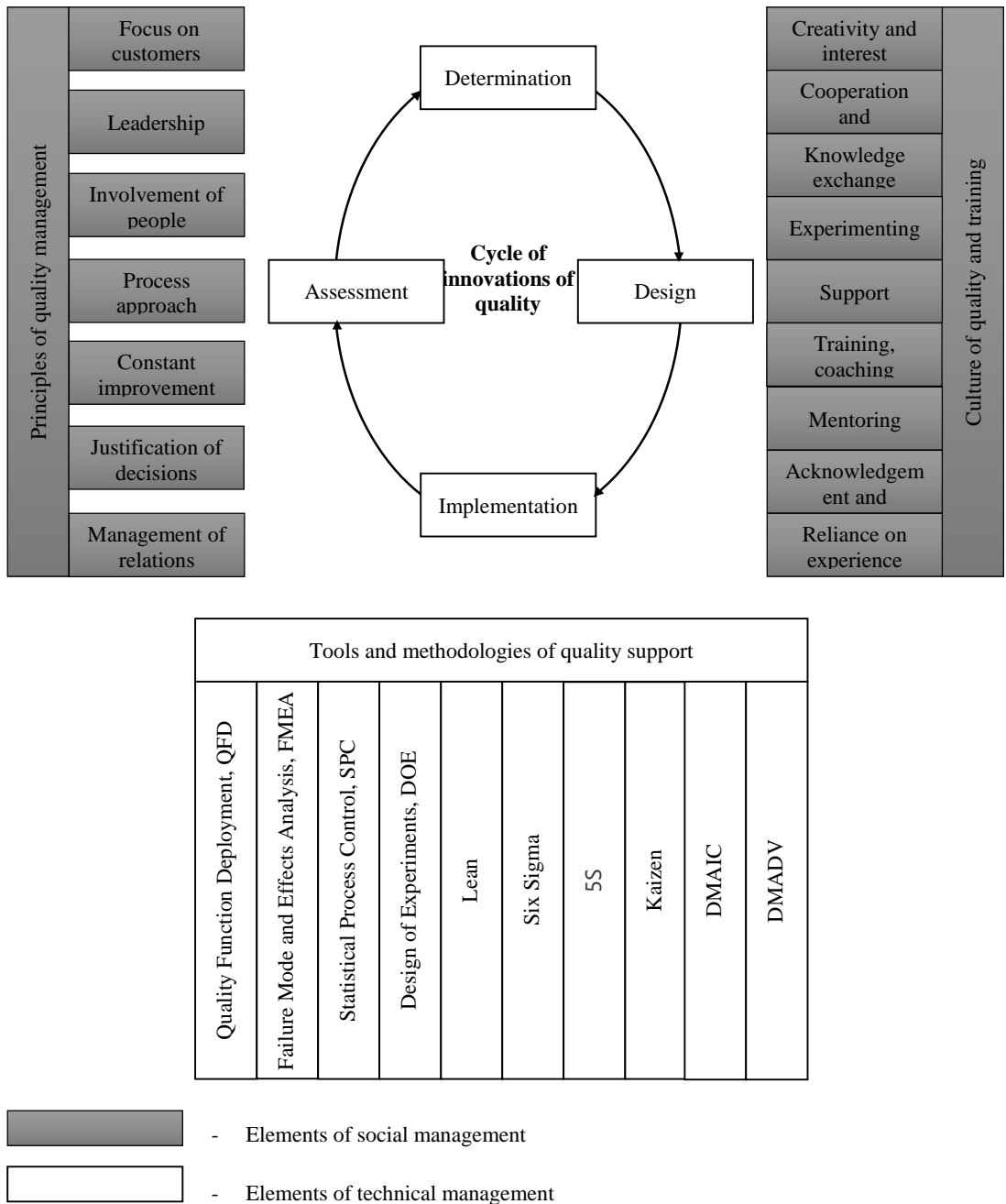
#### **4. Results**

Quality management in companies could be implemented due to the use of different methods or their combinations. The basis of the quality management system is standards ISO 9001 and ISO 14001, total quality management, systems of effective production and quality control, management of defects, risk management, etc. Numerous studies confirm the high effectiveness of the use of these methods and their positive impact not only on product quality but also on the results of the activities of the entire company (Abdallah et al., 2021; Bhadu et al., 2022). An increase in competitive struggle and technological development raises the relevance of innovations and the fight for quality. The mutual dependence of the market, competition, and innovations predetermines the existence of trends

according to which the demands of consumers constantly change. There appears a closed cycle, in which demands for product quality grow through innovations and competition. Breaking this cycle of studying the market needs, searching for new ways to meet them, bringing new or improved products into the market, and going through competition against rivals, which work similarly, we simply drop out of the market. Therefore, innovative development and quality management are strategically important directions for activities for modern companies (Crv, 2023).

The described processes, apart from the direct influence on the competitive struggle of the company, from additional limitations, according to which leadership in the market is obtained only due to the use of the latest technological innovations, which are constantly updated. Therefore this process is continuous. In certain cases, it allows going beyond the limits of traditional competition, creating a unique proposition or forming a new market.

The system of quality management based on innovations consists of the elements of social and technical management. Social elements are presented by the culture of quality and training and principles of quality management. They determine behavioural foundations of management, which is manifested in the formation of a stable behavioural culture, based on creativity, cooperation, knowledge exchange, responsible experimenting, support, and learning that is based on coaching, mentoring, motivation, and a special attitude towards experience. These elements form the norms and values of the system of quality management and innovations. The correct choice and implementation of the elements of culture and training in the system of the company's management allow creating an active environment, capable of constant production of innovations and resolution of complex problems (Figure 1).



**Figure 1.** System of quality management based on innovations  
 Source: Created by the authors based on (Quality Management, 2024)

Social elements also include the principles of quality management. They supplement value provisions of the management system and specify the criteria of decision-making, which allows manufacturing products that conform to the market demands. These principles include a focus on customers, management of relations, leadership, justification of decisions, involvement of people in the process, and constant improvement and process approach. The above principles form a clear vision and criterial apparatus, which, in the aggregate, ensure the unity of actions and progress of the company.

The cycle of innovations of quality allows integrating the processes of management, aimed at quality and innovations. It covers four main phases:

1. Determination of opportunities and challenges for innovations, which form outside of the company and influence it;
2. Design of decisions and development of their prototypes, aimed at the use of opportunities and reduction of threats from the external environment;
3. Implementation of decisions that are aimed at the use of the tools of project management and quality control;
4. Assessment of the level of the influence of decisions on the state of quality and productiveness of the company.

The above cycle belongs to the elements of technical management and has a closed character. Each of its elements comes from the previous one and continues into the next one, thus creating a continuous process of improvement based on the elimination of the problems of the previous cycle and the increase in opportunities it offers.

The tools and methodologies of ensuring quality perform the role of the main technical elements. They ensure quality changes in the system of quality

management, solving different problems of quality management. At that, each tool and method solves a certain task. Thus, Quality Function Deployment (QFD) formalises consumers' demands for products and turns them into constructive features and technical parameters. Failure Mode and Effects Analysis (FMEA) allows systematising risks and possible failures, determining their priority and connecting them. Statistical Process Control (SPC) allows controlling deviations in processes due to the use of statistical methods. Design of Experiments (DOE) is a method of testing and optimisation of the influence of the totality of factors on processes and products that is achieved due to the use of experimental design. Lean and Six Sigma are methods aimed at the optimization of the processes of management, elimination of defects, and improvement of the effectiveness and productiveness of the system. 5S is a method that allows creating ergonomic, safe, and effective workplace. Kaizen is a Japanese philosophy of constant improvement of quality due to the involvement of all employees in the process. DMAIC is a complex methodology for the improvement of processes due to the "define, measure, analyze, improve, control" algorithm. DMADV is a complex methodology for developing new processes and products based on the "Define-Measure-Analyze-Design-Validate" algorithm.

Despite its importance, quality is just one of the criteria for success in the market. There are many other challenges and demands, each of which is taken into account to a certain extent in the process of decision-making. Such criteria belong to different spheres of companies' activities and define economic (e.g., economic effectiveness, profitability, stock indices, market share), social (personnel turnover, loyalty of employees and customers, level of inclusion), and environmental (CO<sub>2</sub> emissions, contribution to natural biodiversity) goals.



From the position of managerial decisions, all criteria and goals influence the company’s activities through their integration in the process of development and making of these decisions at different levels. At that, the process of decision-making, from the position of quality management, is connected with the conflict of different interested parties, each of which has its goals and strategies of behaviour.

Such interaction in the theory of managerial decision-making can be formalised and expressed with the help of the methodology of game theory.

For example, a situation on investing in the system of quality management of the company has the interests of several stakeholders, each of which uses its strategy and sees success in a different way (Table 1).

**Table 1.** Formalisation of the strategies and functions of success of the stakeholders in the process of product quality management

Players	Strategies	Functions of player’s success (win)
Managers, investors	To invest or not to invest in innovations for quality management	Maximisation of profit
Department of quality	To implement or not to implement new methods of quality control	Minimisation of product defects
Production departments	To modernise or not to modernise processes connected with product quality	Maximisation of quality for affordable price
Consumers	To buy or not to buy the manufacturer’s products	Minimisation of expenditures

Source: Created by the authors based on (Noronha et al., 2023; Virmani et al., 2023)

The task of this method is to determine an equilibrium situation in which sets of strategies balance the interests of all players in the best possible way. According to Table 1, this involves the achievement of a compromise on the volume of profit, achievement of parameters of quality (number of defects), and expenditures for quality and prices. Each player can choose from among two strategies:  $s_i = 0$  or  $s_i = 1$ . In the first case, players have no expenditures, because they do not perform any actions (investors do not invest money in the improvement of quality, the department of quality does not introduce new methods of quality management, production is not modernised, and consumers do not buy products). In the second case, players have expenditures according to their interests.

The function of success (win) of investors  $u_1$  involves such a combination of the strategies of all participants ( $s_1, s_2, s_3, s_4$ ) at which the maximum excess of profit (P) from innovations over costs (C) of their

implementation is achieved:  $u_1(s_1, s_2, s_3, s_4) = P - C$ . The function of the success of the department of quality  $u_2$  is based on determining the combination of the strategies of players that allow minimising the number of defects of products (D) at production  $u_2(s_1, s_2, s_3, s_4) = -D$ . The function of success (win) of production departments  $u_3$  is aimed at minimisation of costs of modernisation (M) of equipment  $u_3(s_1, s_2, s_3, s_4) = -M$ . For consumers, such function of success (win) is the maximum difference between quality (Q) and price (p) for products  $u_4(s_1, s_2, s_3, s_4) = Q - p$ .

Within the presented model, the choice of the strategy – to act or not to act – of some players influences the decision of other players. Thus, investors’ decision to invest in the improvement of product quality  $s_1=1$  facilitates a decrease in the number of product defects and pushes the department of quality towards action  $s_2=1$ . At the same time, this decision facilitates an increase in

expenses for the modernisation of equipment and pushes production departments towards the refusal of action  $s_3=0$ . If the production department decides to act  $s_3=1$ , there will be, together with an increase in expenses for modernisation, an improvement in product quality. As a result, the decisions of consumers  $s_4$  depend on the change in the proportion of quality and product price, which grow as a result of other players' choices. If an increase in quality exceeds the growth of price, consumers tend to choose the strategy of action (purchase)  $s_4=1$ ; in the opposite case, they refuse the purchase  $s_4=0$ . One of the variants of balance is the strategy  $u_i(1,1,1,1)$ , at which all participants decide to act, and this leads to the result that pushes other players towards the same positive decision, based on rational motives.

Similar models could be used for modelling players' behaviour in a situation of competitive struggle. In such a situation, players are the company that makes decisions on the implementation of innovations and its rivals. The function of a win for such a company is  $u_1(s_1, s_2, \dots, s_n) = P_1(s_1, s_2, \dots, s_n) - C_1(s_1)$ , at which profit depends not only on the company's decision but also on its rivals, while expenses depend only on its actions. For rivals, the function of win will have a similar form:  $u_i(s_1, s_2, \dots, s_n) = P_i(s_1, s_2, \dots, s_n) - C_i(s_i)$ . A possible balance of such a situation is the simultaneous implementation of innovations by all players ( $s_1=1, s_2=2, \dots, s_n=1$ ). At that, the following conditions must be met:

$$u_1(1,1,\dots,1) > u_1(0,1,\dots,1)$$

$$u_2(1,1,\dots,1) > u_2(1,0,\dots,1)$$

...

$$u_n(1,1,\dots,1) > u_n(1,1,\dots,0)$$

A situation in which one of the players does not implement innovations is the least desirable for him. Such a model could be used also for decision-making based on competition or cooperation.

From the position of game theory, innovations can change competitive balance, influencing expenses or profits or raising quality. The Cournot model and the Bertrand model of competition are used for the description of such strategies (Fanti & Gori, 2023). The Cournot model describes the influence of innovations on expenses, which reflects the competition by volumes. In this case, players are rival companies, their strategies are issues of products in the market, and utility functions are profits of companies that depend on the volume and price of products sold. In this model, innovations solve the task of reducing the cost or raising productiveness, which, eventually, leads to the reduction of price.

The Bertrand model describes the influence of innovations on demand, which is achieved due to an increase in product quality. Strategies in such models are product prices, utility functions are based on the dependence of demand and profit on price. According to this, the market's reaction to an increase in product quality, which is accompanied by the growth of price, is studied. A solution in such a model is the conclusion on the maximum growth of price, which conforms to the market's ideas of the growth of product quality. There are situations in which investing in the quality of products is senseless because of zero profit, which is a result of the growth of price – which does not conform to the market's interests.

## 5. Discussion

The problem of quality management due to the use of innovations is among the relevant directions for scientific research. It is in the active phase of discussion, which also covers the aspects of methodological substantiation of the theory of decision-making in the described spheres. Thus, the presented results provide a large field for discussion. Additional discussion is needed for the problem of determining the top-priority directions for innovations, which ensure the largest effect in the sphere of quality

management. In this context, it is important to develop a methodology of portfolio analysis, which would allow determining the most rational direction for the use of companies' limited resources.

Another important problem is the integration of the tools of innovative development in the system of quality management of the company. Thus, attention should be paid to the expedience of developing a mechanism of determining innovations that are relevant from the position of quality of innovations, receipt of access to them, and quick implementation in the activities of the company and the quality management system. Special attention should be paid to the need to study the effectiveness of innovations from the position of their influence on the change (improvement) in quality and the growth of economic effectiveness and productiveness of the company.

Another direction of the discussion is the use of game theory as a tool for substantiating managerial decisions within the designated problems. This is because together with advantages, game theory has also significant limitations and reservations on the use of its methods for decision-making in the sphere of product quality management with the help of innovations. The main reservation is the simplified character of situations, which are described and solved by game theory. Another important limitation of this theory is the key assumption of the rationality of all players' actions, which is manifested in the possibility of forecasting their behaviour. Apart from this, the limitations of this theory are its static character, the impossibility of taking into account the uncertainty and risks, multiple numbers of possible balances, and the complexity of the quantitative measuring of the win and probability of different actions. A real situation in which decisions are made is much more complex, dynamic, and risky. Thus, to raise the justification of the solution made on the basis of modelling with the help of game theory it is necessary to combine several methods.

At any rate, further studies of methodological provisions on managerial decision-making in the sphere of the use of innovations for product quality management have a large potential and deserve the attention of scholars and researchers.

## **6. Conclusions**

In the conditions of the dynamic competitive environment, quality is the key factor in ensuring competitive advantages. Product quality management cannot ignore innovative developments, since they offer the most efficient tools for ensuring the correspondence of products' parameters to the market's demands that constantly change. For the complete use of innovations in the system of quality management, it is important to have access to and possess tools for substantiating managerial decisions, which requires an in-depth assessment of the situation, analysis of possible alternatives, and selection of the optimal variant of actions in the current conditions.

The methodology of decision-making in dynamic socioeconomic systems that are closely connected with technological processes is a complex interdisciplinary system combining a theory of decision-making, the concept of quality management and innovations, the methods of general management, economic theory, etc. Given the fact that product quality management is a complex multifactor process, decision-making in this sphere requires serious preparation, which includes assessment and analysis of economic, social, and technological aspects. The methodology of decision-making in this sphere must combine standard tools and stages with specific features peculiar to the sphere of quality management and innovations, which are rather differentiated in different companies.

Directions for improvement of product quality of the company due to innovations are not focused narrowly on novel technologies that are accessible to the

company. They go beyond their limits and can cover innovative solutions of the supply chain sphere, in which innovations of one participant influence all others, including the general quality of products for the final consumer. From the position of Industry 4.0, quality management can form a separate sustainable system, which is called Quality 4.0, within which the most comprehensive and flexible combination of digital technologies with the system of quality management takes place.

Despite the advantages offered by the new technological mode, the focus only on digital technologies from the position of quality does not have to be comprehensive. One of the reasons for such a situation is complex economic interactions in the market, according to which the change in product quality is reflected in the price, which transforms market offers and influences the behaviour of market players. In such conditions, the use of game theory for modelling the influence of innovations on

quality and market proportions is a valuable tool that offers a clear and deep understanding of the situation.

Within these methodological conditions of decision-making on quality management based on innovations, it is important to ensure the functioning of a complex system of quality management at companies, which would include social and technical tools. Given the dynamics of the environment, it is important to ensure a quick cycle of innovations within the company, which will allow for their quick implementation, achievement of the planned level of product quality, and the use of competitive advantage before the innovation becomes widespread. This sets strict requirements for the system of quality management regarding flexibility and adaptability

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