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QUALITY MANAGEMENT IN HIGH-TECH PROJECTS USING DIGITAL MARKETING TECHNOLOGIES IN KAZAKHSTAN

Abstract

The purpose of this article is to determine the contribution of digital marketing technologies to improving the quality of high-tech products in Kazakhstan, as well as to identify prospects for improving quality management practices in high-tech projects in Kazakhstan using a digital approach to marketing. Based on international statistics from IMD and WIPO for 2013–2022, using the correlation analysis method, the results of implementing high-tech projects in quality management using alternative approaches (digital and pre-digital) to marketing in Kazakhstan are compared. The key conclusion is that in Kazakhstan, quality management in high-tech projects using digital marketing technologies is preferable. The key ones are: personnel marketing, product marketing and process marketing. The theoretical significance of the obtained results is that they allowed us to rethink quality management processes in the implementation of high-tech projects in the digital economy of Kazakhstan, and also revealed promising digital marketing technologies based on AI, IoT, Big Data, the Internet, mobile devices, chatbots, machine vision, smart consultants and virtual assistants (VR / AR). The practical significance is due to the fact that the developed digital approach to marketing allows us to improve the practice of quality management in high-tech projects in Kazakhstan. The author's approach includes a marketing mix of quality management in high-tech projects using digital marketing technologies in Kazakhstan. The approach also reveals the organizational and technological aspects of quality management in high-tech projects in Kazakhstan with a digital approach to marketing.

Key words: quality management, high-tech projects, digital marketing technologies, digital economy of Kazakhstan.

Introduction

The fourth industrial revolution has not only increased the importance of quality for the success of high-tech projects, but also opened up new technological opportunities for quality management. The marketing approach to quality management is preferable when implementing high-tech projects, since this approach ensures the highest management flexibility and, accordingly, the most complete consideration of stakeholders' interests, thereby forming and strengthening the competitiveness of high-tech industries and their products.

Digital technologies can improve the efficiency of marketing and increase its reach. For example, chatbots can provide information and consulting support to consumers in the field of product quality. Intelligent support for making purchase decisions helps compare substitute products based on quality criteria, taking into account consumer priorities. Digital marketing communications can be carried

out continuously and transformed as needed – from mass mailings to individual commercial offers. This determines the relevance of studying the possibilities of applying digital marketing technologies to quality management in high-tech projects.

The digital economy is actively developing in Kazakhstan. Its institutional framework is regulated by the state program "Digital Kazakhstan", approved by the Resolution of the Government of the Republic of Kazakhstan (2023) dated December 12, 2017, No. 827. Over the five-year period of implementation of the program, which ends in 2022, significant successes have been achieved. Thus, according to IMD (2023), Kazakhstan took 36th place among 63 countries in the world in digital competitiveness in 2022, the level of which in Kazakhstan is estimated at 73.03 points out of 100 possible. According to WIPO (2023), the share of high-tech production in Kazakhstan in 2022 is 15.3%, and the share of high-tech exports is estimated at 5.2% of total foreign trade. Quality management plays a key role in the development of high-tech production. Historically, thanks to the Soviet legacy, the high quality of Kazakh products was ensured through state standardization and quality control. The fruitfulness and completeness of market reforms to date have ensured the institutionalization of marketing management of high-tech projects in Kazakhstan. However, the implementation of marketing in quality management in itself is an innovation for Kazakhstan, to which both Kazakh business and Kazakh society, including consumers of high-tech products, need to adapt. The problem is that this hinders the application of digital marketing technologies in quality management in Kazakhstan, which, as the experience of other countries shows (Wang et al., 2022; Zhang et al., 2023), can be useful in high-tech projects. The purpose of this article is to determine the contribution of digital marketing technologies to improving the quality of high-tech products in Kazakhstan, as well as to identify prospects for improving quality management practices in high-tech projects in Kazakhstan using a digital approach to marketing.

The originality of the study and its contribution to the literature is that it proposes a new – digital approach to marketing, taking into account the specifics of the digital economy of Kazakhstan and allowing to improve quality management in high-tech projects in Kazakhstan. Further in this article, a literature review is conducted, after which the materials and methods of the study are described. Then the results of solving two problems of this study are presented. The first problem is related to comparing the results of implementing high-tech projects in quality management using alternative approaches to marketing in Kazakhstan. The second problem is to develop a digital approach to marketing to improve quality management in high-tech projects in Kazakhstan. The work concludes with a discussion and conclusion.

Literature Review

Theoretical basis of project quality management and the specifics of high-tech projects.

This article focuses on the concept of project quality management, interpreted as the implementation of a set of organizational and managerial measures aimed at ensuring the highest possible quality of project results, that is, the final product of the project (El Khatib et al., 2023$ Mohamed and Tran, 2023; Veselovsky et al., 2018).

In this regard, the most important parameter of project quality is the quality of the products manufactured and sold on the market as a result of the project (Alawag et al., 2023; Coghlan et al., 2023). Consequently, the main criterion for quantitative (i.e. accurate, objective and reliable) assessment of project quality is the volume of demand in the short term, and the volume of production of project products in the medium and long term (Miao et al., 2021; Painén-Paillalef et al., 2022).

The theoretical basis of this study is the concept of quality management in high-tech projects that develop and manufacture high-tech products, including digital products and products of Industry 4.0 (Duan et al., 2023; Lin et al., 2023; Popkova, 2020a; Popkova, 2020b; Popkova, 2022; Popkova, 2023).

The specificity of assessing the quality of high-tech projects is that the demand for high-tech products is consistently high, provided that they are of good quality. In this regard, the volume

of high-tech production acts as the main parameter of the quality of high-tech projects, which is obviously dictated by the existing demand, determined by the quality of the products (Ng, 2022; Yamnitsky and Jankowicz, 2021).

Digital Marketing Technologies and Their Application for Quality Management in High-Tech Projects

Digital marketing technologies in this article, based on existing literature Gupta and Singh (2023), Jung and Shegai (2023), are understood as digital technologies used in business marketing activities. Marketing technologies applicable in project quality management, including high-tech projects, are personnel marketing, product marketing, promotion (branding) and process marketing technologies. In the existing literature, the following are noted as key elements of the marketing mix, the most significant for product quality management in high-tech projects.

Firstly, personnel marketing: high-tech projects involve knowledge-intensive jobs occupied by highly qualified personnel. Marketing management of these personnel allows for the fullest development of their human potential through relationship marketing, strengthening loyalty, forming a responsible employer brand and a flexible approach to labor incentives (Bejtkovsky, 2018; Jančíková and Milichovský, 2019).

Knowledge-intensive employment acts as a classic (pre-digital) personnel marketing technology that influences quality, since this technology helps to attract and retain the best personnel (Hrivnák et al., 2021). The technology of digital personnel marketing is the attraction of digital personnel and the development of digital skills (competencies) in employees, which is particularly useful for the implementation of high-tech projects (Vanchukhina et al., 2022). Secondly, product marketing: a close connection with the market allows designing and producing products of the exact quality that is in demand (Anderson and Laverie, 2022; Veselovská, 2022). Industrial design of products acts as a classic (pre-digital) product marketing technology that influences quality (Bogoviz and Ragulina, 2020). Digital product marketing technology is the digital transformation of business, which allows producing and selling digital products on the market (Benčič et al., 2020). Thirdly, promotion (branding): a strong brand and reputation as a reliable supplier allows promoting innovative high-tech products on the market, stimulating demand for them due to their high quality (Ibrahim and Aljarah, 2023; Xu et al., 2023). A classic (pre-digital) promotion (branding) technology that influences quality is image abroad or branding (Pantano et al., 2020). A digital promotion (branding) technology is electronic product promotion (Chen, 2023), in particular, when selling products through e-commerce with electronic payments between sellers and buyers (Evstratov and Berezhnova, 2013). Fourth, process marketing: marketing allows for the close integration of all business processes in the implementation of high-tech projects and focuses them on improving product quality in close connection with the market (Akter et al., 2023; Jasin and Firmansyah, 2023). A classic (pre-digital) process marketing technology that influences quality is quality certification according to ISO 9001 (Parra-López et al., 2016). The technology of digital marketing processes is the use of big data and smart analytics, which is especially useful in the implementation of high-tech projects (Medhat and Bayomy, 2023).

Gap Analysis and Research Question (RQ)

The specifics of digital marketing related to relying on digital technologies in the implementation of business marketing activities are disclosed in the works of Haverila et al. (2023), Zahoor and Lew (2023). At the same time, the issues of using digital marketing technologies in quality management in high-tech projects have not been sufficiently studied, which is a gap in the literature. The experience of implementing high-tech projects in Kazakhstan is disclosed in separate publications by Konovalov and Beisenbaieva (2018), Kurmanov et al. (2022), Sadykhanova et al. (2019) and needs to be studied in more depth, in particular, from the standpoint of marketing.

The research question of this article is as follows. RQ: What is preferable for quality management in high-tech projects in Kazakhstan – pre-digital marketing or digital marketing? To find an answer to the RQ, the article studies the experience of applying marketing in quality management in high-

tech projects in Kazakhstan and compares the contribution of pre-digital and digital marketing technologies to improving quality.

Materials and Methods

Research Methodology and Control Variables
To achieve the stated goal, the article consistently solves the following two tasks. The research design is presented in Fig. 1.
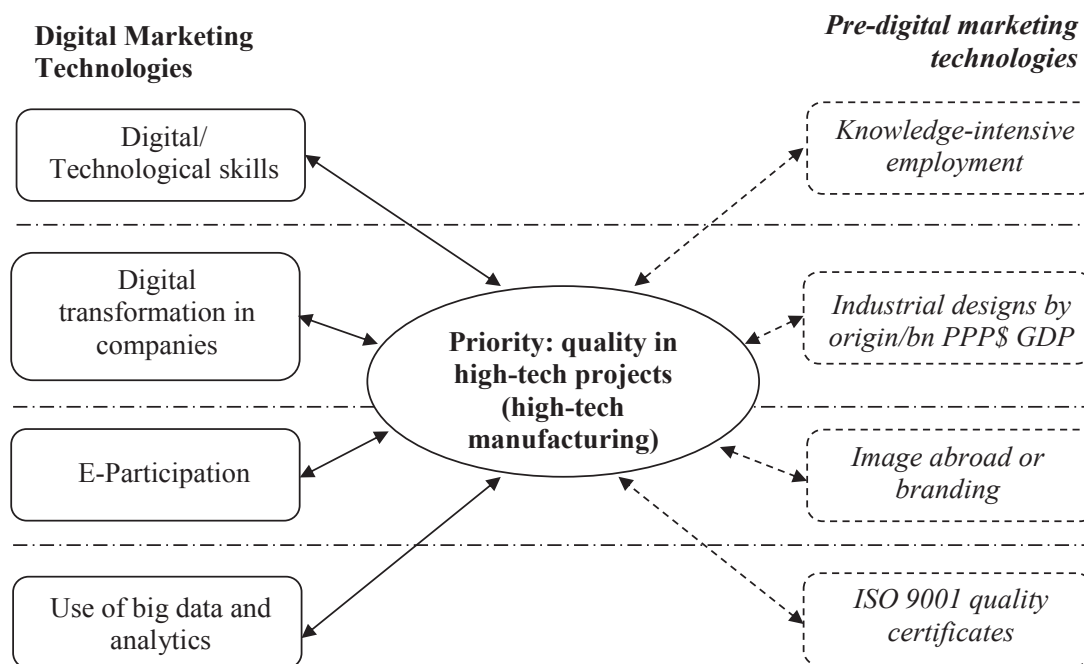

Figure 1 – Research design

Source: original development

As shown in Figure 1, the research design involves establishing a connection between quality in high-tech projects (high-tech manufacturing), on the one hand, and pre-digital marketing technologies, on the other hand, and digital marketing technologies. The object of the study is high-tech projects implemented in Kazakhstan and taken into account in statistics on the indicator "high-tech manufacturing" (WIPO, 2023). According to the definition of the World Bank (2023), this includes "products with high R&D intensity, such as aerospace, computers, pharmaceuticals, scientific instruments and electrical equipment".

The first task: to compare the results of the implementation of high-tech projects in quality management using alternative approaches to marketing in Kazakhstan. For this, the method of correlation analysis is used. This method is used to determine the relationship (correlation dependence) of the "high-tech manufacturing" indicator (as an indicator of the effectiveness of quality management in high-tech projects according to WIPO, 2023) with the elements of the marketing mix in comparison of pre-digital and digital marketing. The control variables are selected in accordance with the marketing technologies for project quality management identified in the literature review and supported by the literature, they are presented in Table 1.

The time frame of the study covers 2013–2022. The empirical basis of the study is given in Table 2.

Table 1 – Control variables

Marketing Technologies	Digital Marketing		Pre-Digital Marketing	
	Statistical indicator	Data source	Statistical indicator	Data source
Personnel Marketing	Digital/Technological skills	IMD (2023)	Knowledge-intensive employment, %	WIPO (2023)
Product Marketing	Digital transformation in companies	IMD (2023)	Industrial designs by origin/bn PPP$ GDP	WIPO (2023)
Promotion (Branding)	E-Participation	IMD (2023)	Image abroad or branding	IMD (2023)
Process Marketing	Use of big data and analytics	IMD (2023)	ISO 9001 quality certificates/bn PPP$ GDP	WIPO (2023)

Source: author's development.

The second task: development of a digital approach to marketing to improve quality management in high-tech projects in Kazakhstan. Based on the marketing mix method, a marketing mix of quality management in high-tech projects is developed using digital marketing technologies in Kazakhstan, and organizational and technological aspects of quality management in high-tech projects in Kazakhstan with a digital approach to marketing are determined.

Results

Quality Management in High-Tech Projects in Kazakhstan with Alternative Marketing Approaches
As part of the first task of this study, a correlation analysis of the data from Table 2 was conducted to compare the results of implementing high-tech projects with quality management using alternative marketing approaches in Kazakhstan. The results are illustrated in Fig. 2.
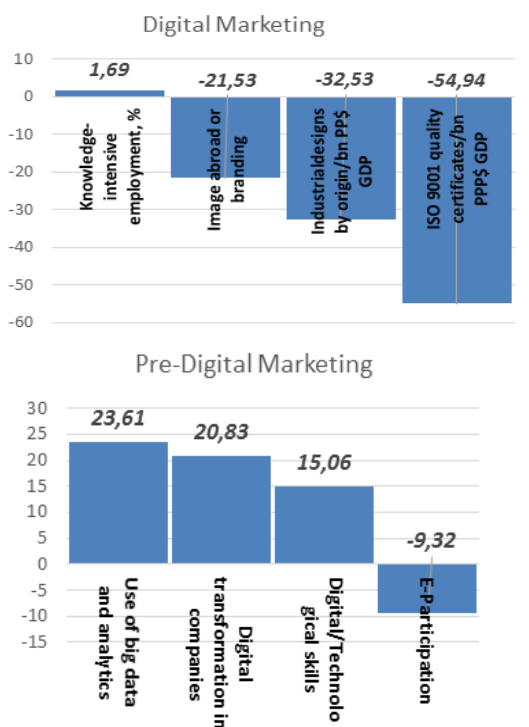

Figure 2 – Correlation of pre-digital and digital marketing technologies
with quality in the implementation of high-tech projects in Kazakhstan, %

Source: calculated and constructed by the author.

As can be seen from Figure 2, pre-digital marketing technologies for the most part demonstrated a negative correlation with quality in the implementation of high-tech projects in Kazakhstan. The only positive value of the correlation coefficient was obtained for the relationship of knowledge-intensive employment, but it is negligibly small (1.69%). It is noteworthy that promotion (branding) did not demonstrate a positive relationship with quality in the implementation of high-tech projects in Kazakhstan, either when using pre-digital marketing tools (the correlation was –21.53%) or when using digital marketing tools (-9.32%). In general, a moderate relationship was found between other digital marketing tools and quality in the implementation of high-tech projects in Kazakhstan, which amounted to 23.61% for process marketing based on big data and analytics, 20.83% for product marketing in digital transformation in companies, and 15.06% for personnel marketing with digital/technological skills. This indicates the preference for digital marketing tools for quality management in the implementation of high-tech projects in Kazakhstan.

A digital approach to marketing to improve quality management in high-tech projects in Kazakhstan

Table 2 – Organizational and technological aspects of quality management in high-tech projects in Kazakhstan with a digital approach to marketing

Marketing mix element in the 7P	Specifics of the element in the digital approach to marketing	Recommended digital technologies for use	Advantages for quality management in high-tech projects
P1: Product	automation of product design and production	AI, IoT	development and high-precision production of more technically complex products
P2: Price	pricing based on the e-commerce mechanism	Big Data	establishing and maintaining a close relationship between price and quality
P3: Place	electronic marketplace	Internet	it is possible to produce both template and unique products
P4: Promotion	promotion on the Internet and on social networks	Internet, mobile devices	«smart» market segmentation based on quality preferences
P5: Process	electronic collection of feedback from consumers	chatbots (AI)	continuity of product quality improvement processes
P6: People	marketing of digital personnel	machine vision (AI, IoT)	reducing the «human factor» and reducing the proportion of marriage
P7: Physical evidence	sales automation with intellectual support for making purchase decisions	«smart» consultants (AI), virtual assistants (VR/AR)	rationalization of customer behavior based on product quality

Source: original development.

As shown in Table 2, with a digital approach to marketing, quality management in high-tech projects in Kazakhstan in P1: Product involves the automation of product design and production using artificial intelligence (AI) and the Internet of Things (IoT) technologies, which will ensure the development and high-precision production of more technically complex products.

P2: Price involves pricing based on the mechanism of electronic commerce using Big Data, which will ensure the establishment and maintenance of a close connection between price and quality.

P3: Place involves electronic marketplaces using the Internet, which will ensure the possibility of producing both standard and unique products according to individual orders.

P4: Promotion involves promotion on the Internet and social networks using technologies such as the Internet and mobile devices, which will ensure "smart" market segmentation based on the criterion of preferences regarding quality.

P5: Process involves electronic collection of feedback from consumers using chatbots based on artificial intelligence (AI) technologies, which will ensure the continuity of product quality improvement processes.

P6: People involve digital personnel marketing using machine vision based on AI and IoT technologies, which will reduce the "human factor" and reduce the share of defects.

P7: Physical evidence involves automation of sales with intelligent support for purchasing decisions using "smart" consultants (AI), virtual assistants (using virtual and augmented reality technologies – VR / AR), which will ensure rationalization of purchasing behavior taking into account product quality.

Discussion

The article contributes to the literature by developing the concept of quality management in high-tech projects in which high-tech products are developed and manufactured (Table 3).

Table 3 – Comparison of new results obtained in the article with existing literature

Field of comparison		Existing literature	New results obtained in the article
Marketing mix elements that are important for quality management	Personnel Marketing	significant (Bejtkovsky, 2018; Jančíková and Milichovský, 2019)	significant (correlation with quality: 15.06%)
	Product Marketing	significant (Anderson and Laverie, 2022; Veselovská, 2022)	significant (correlation with quality: 20.83%)
	Promotion (Branding)	значим (Ibrahim and Aljarah, 2023; Xu et al., 2023)	Not significant (correlation with quality: -9.32%)
	Process Marketing	significant (Akter et al., 2023; Jasin and Firmansyah, 2023)	significant (correlation with quality: 23.61%)
Marketing approach for quality management in high-tech projects in Kazakhstan		pre-digital approach (Haverila et al., 2023; Wang et al., 2022; Zahoor and Lew, 2023; Zhang et al., 2023)	digital approach

The marketing mix elements that are significant for quality management are rethought taking into account the unique experience of Kazakhstan. In support of Bejtkovsky (2018), Jančíková and Milichovský (2019), the importance of personnel marketing is confirmed (correlation with quality: 15.06%). In support of Anderson and Laverie (2022), Veselovská (2022), the importance of product marketing is proven (correlation with quality: 20.83%). In support of Akter et al. (2023), Jasin and Firmansyah, (2023), the importance of process marketing is substantiated (correlation with quality: 23.61%). In contrast to Ibrahim and Aljarah, (2023), Xu et al. (2023) the insignificance of promotion (branding) is substantiated (correlation with quality: -21.53% for pre-digital marketing and -9.32% for digital marketing).

Unlike FIO, it is substantiated that for quality management in high-tech projects in Kazakhstan, a digital approach to marketing is preferable, the advantages of which are the following: greater technical complexity of products, a closer relationship between price and quality, a wider range of products from the standpoint of quality, more accurate market segmentation based on the criterion of preferences regarding quality, continuity of product quality improvement processes, reduction of the "human factor" and reduction in the share of defects, a close relationship between demand and quality.

Conclusion

The key conclusion from the results of the study and the answer to the RQ is that in Kazakhstan, quality management in high-tech projects is preferable using digital marketing technologies. The key ones are: personnel marketing (correlation with quality: 15.06%), product marketing (correlation with quality: 20.83%) and process marketing (correlation with quality: 23.61%).

A digital approach to marketing has been developed to improve quality management in high-tech projects in Kazakhstan. The author's approach includes a marketing mix of quality management in high-tech projects using digital marketing technologies in Kazakhstan. The approach also reveals the organizational and technological aspects of quality management in high-tech projects in Kazakhstan with a digital approach to marketing.

The theoretical significance of the results obtained is that they allowed us to rethink quality management processes when implementing high-tech projects in the digital economy of Kazakhstan, and also revealed promising digital marketing technologies based on AI, IoT, Big Data, the Internet, mobile devices, chatbots, machine vision, "smart" consultants and virtual assistants (VR / AR). The practical significance of the developed digital approach to marketing is related to the fact that it allows improving the quality management practice in high-tech projects in Kazakhstan and provides the following advantages: increasing the technical complexity of products, establishing a closer connection between price and demand with quality, expanding the range of products from the standpoint of quality, more accurate market segmentation based on the criterion of preferences regarding quality, continuity of product quality improvement processes, reducing the "human factor" and reducing the share of defects in the implementation of high-tech projects.

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ҚАЗАҚСТАНДАҒЫ ЦИФРЛЫҚ МАРКЕТИНГ ТЕХНОЛОГИЯЛАРЫН ҚОЛДАНУ АРҚЫЛЫ ЖОҒАРЫ ТЕХНОЛОГИЯЛЫҚ ЖОБАЛАРДАҒЫ САПАНЫ БАСҚАРУ

Аңдатпа

Бұл мақаланың мақсаты – Қазақстандағы жоғары технологиялық өнімдердің сапасын арттыруға цифрлық маркетинг технологияларының қосқан үлесін анықтау, сондай-ақ цифрлық маркетинг әдісі арқылы Қазақстандағы жоғары технологиялық жобалардағы сапаны басқару тәжірибесін жетілдіру болашағын айқындау. IMD және WIPO-ның 2013–2022 жж. халықаралық статистикасына сүйене отырып, корреляциялық талдау әдісі арқылы Қазақстандағы жоғары технологиялық жобаларды жүзеге асыру нәтижелері сапаны басқаруда маркетингке балама тәсілдерді (цифрлық және цифрға дейінгі) қолдану арқылы салыстырылды. Негізгі қорытынды – Қазақстанда жоғары технологиялық жобаларда сапаны цифрлық маркетингтік технологияларды пайдалана отырып басқарған жөн. Олардың негізгі бағыттары: персонал маркетингі, өнім маркетингі және процесс маркетингі. Алынған нәтижелердің теориялық маңыздылығы Қазақстанның цифрлық экономикасында жоғары технологиялық жобаларды жүзеге асыру кезінде сапаны басқару процестерін қайта қарастыруға мүмкіндік бергендігінде, сондай-ақ AI, IoT, Big Data, интернет, мобильді құрылғылар, чат-боттар, машиналық көру, «ақылды» кеңесшілер мен виртуалды көмекшілер (VR/AR) негізіндегі перспективалы цифрлық маркетинг технологияларын ашып көрсеткендігінде. Тәжірибелік маңыздылығы – маркетингтің дамыған цифрлық тәсілі Қазақстандағы жоғары технологиялық жобаларда сапаны басқару тәжірибесін жетілдіруге мүмкіндік береді. Авторлық тәсіл Қазақстандағы цифрлық маркетингтік технологияларды пайдалана отырып, жоғары технологиялық жобаларда сапаны басқару маркетингтік кешенін қамтиды. Бұл тәсіл сондай-ақ Қазақстандағы high-tech жобаларында сапаны басқарудың ұйымдық-технологиялық аспектілерін цифрлық маркетинг тәсілін қолдану арқылы ашып көрсетеді.

Тірек сөздер: сапаны басқару, high-tech жобалары, цифрлық маркетингтік технологиялар, Қазақстанның цифрлық экономикасы

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УПРАВЛЕНИЕ КАЧЕСТВОМ В ВЫСОКОТЕХНОЛОГИЧНЫХ ПРОЕКТАХ С ИСПОЛЬЗОВАНИЕМ ТЕХНОЛОГИЙ ЦИФРОВОГО МАРКЕТИНГА В КАЗАХСТАНЕ

Аннотация

Целью этой статьи является определение вклада цифровых маркетинговых технологий в повышение качества высокотехнологичной продукции в Казахстане, а также выявление перспектив совершенствования практики управления качеством в высокотехнологичных проектах в Казахстане с помощью цифрового подхода к маркетингу. С опорой на международную статистику IMD и WIPO за 2013–2022 гг. с помощью метода корреляционного анализа сопоставлены результаты реализации высокотехнологичных проектов при управлении качеством с использованием альтернативных подходов (цифрового и доцифрового) к маркетингу в Казахстане. Ключевой вывод состоит в том, что в Казахстане предпочтительно управление качеством в high-tech проектах с помощью цифровых маркетинговых технологий. Ключевыми из них являются: маркетинг персонала, маркетинг продукта и маркетинг процессов. Теоретическая значимость полученных результатов состоит в том, что они позволили переосмыслить процессы управления качеством при реализации высокотехнологичных проектов в условиях цифровой экономики Казахстана, а также раскрыли перспективные цифровые маркетинговые технологии с опорой на AI, IoT, Большие данные, Интернет, мобильные устройства, чат-боты, машинное зрение, «умных» консультантов и виртуальных помощников (VR/AR). Практическая значимость связана с тем, что разработанный цифровой подход к маркетингу позволяет усовершенствовать практику управления качеством в high-tech проектах в Казахстане. Авторский подход включает в себя маркетинг микс управления качеством в high-tech проектах с помощью цифровых маркетинговых технологий в Казахстане. Подход также раскрывает организационно-технологические аспекты управления качеством в high-tech проектах в Казахстане при цифровом подходе к маркетингу.

Ключевые слова: управление качеством, high-tech проекты, цифровые маркетинговые технологии, цифровая экономика Казахстана.