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RESEARCH ARTICLE
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Comparative Evaluation of the Effectiveness of High-tech Project Management: the Experience of Japan, Israel and Kazakhstan

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Abstract

The practical implementation of high-tech projects is becoming essential and relevant throughout the world in the era of the digitalization of various industries. The successful completion of high-tech projects will indeed support the development of domestic markets and the economy's competitiveness. It should be emphasized that high-tech projects often entail ground-breaking inventions and technology, which call for efficient administration. This study attempts to evaluate the connection between project management application procedures and the success of projects in the industrial sectors of nations like Israel, Kazakhstan, and Japan. The main focus of this paper is analyzing high-tech project management in the engineering, green production, chemical and atomic sectors of these three countries. As a result, Japan is ahead of Israel and Kazakhstan. This research also assesses the maturity levels of project management in chosen countries. The study used a systematic literature review, comparative analysis, quantitative data collection methods through interviews, statistical analysis and modelling. As a result, data were obtained on the project performance level in the selected countries, and approaches to managing high-tech projects in the industrial sector were proposed. A process methodology that may be implemented as a map for each set of projects has been created by assessing necessary success steps for high-tech projects. The study also recommends a number of instruments and techniques for Kazakhstan's high-tech project management. According to the findings of the statistical study, their application in the management of high-tech development will help the project be successfully completed.

Keywords: High-Tech Project Management, Project Management, Domestic Business, Digital Economy, Success Business Processes, High-Tech Marketing, Digital Marketing, Economic Management

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1. INTRODUCTION

Kazakhstan's economy is currently making a steady transition to an innovative route of development. High-tech project implementation is given much consideration in this regard. On December 12, 2017, the State Program "Digital Kazakhstan" was approved by Decree of the Government of the Republic of Kazakhstan No. 827. The main goal of the state program "Digital Kazakhstan" is the progressive development of the digital ecosystem to achieve sustainable economic growth, increase the competitiveness of the economy and the nation, and improve the quality of life of the population. On this basis, the topic of development and analysis of the theory and practice of managing high-tech projects is becoming increasingly important due to the ongoing expansion of global competitiveness and the acceleration of technological progress and is one of the most pressing issues at the present time.

To fulfill several tasks of the approved Digital Kazakhstan State Program, Kazakhstani high-tech initiatives are crucial from 2018 to 2022. One of the goals of the program can be achieved through the successful implementation of high-tech initiatives. The purpose of the "Digitalization of the Economy" is to offer a practical initiative consisting of legitimate high-tech initiatives for the digitalization and technological development of various sectors of the economy.

It should be emphasized that high-tech projects are often associated with innovative inventions and technologies that require effective management (Sharma et al., 2008). The successful completion of such initiatives will contribute to the development of domestic business and the competitiveness of the economy. High-tech initiatives use the latest innovations and results of research and development in priority industries and sectors of the economy, according to what is known about them. The main component of such projects is the latest high-tech tools (Kozhakhmetova & Asanova, 2018).

To help domestic trade in the world market, new technological developments are needed. As a result, Kazakhstan seeks to gain a reputation as a country open to developing of technologies and partnerships, as well as a platform for creating advanced digital innovations (Message of the President of the Republic of Kazakhstan to the people of Kazakhstan 2019). While the leadership of Kazakhstan is only developing its high-tech industry, the Japanese leadership has been successful because it offers high-quality goods and services at a reasonable price. Japanese enterprises were able to reduce the cost of goods and services while maintaining a decent level of quality due to the accompanying developed high-tech industry. Japanese firms have increased their share of the global market due to technological progress (Udaltsova et al., 2015).

In turn, Israel ranks second in the list of the most prominent high-tech centers, second only to the famous Silicon Valley in California. Israeli high technology is one of the most important sectors of the country's economy, accounting for more than 11% of the total GDP. This is the highest figure among the 30 largest industrialized countries, along with the United States.

According to Global Finance 2022, compared to 2020, Japan moved from 21st to 7th place in the ranking with a total score of 3.94, Israel from 29th to 10th with a total score of 3.86. However, Kazakhstan ranked 49th with -2.55 while he was 36th with a positive

cumulative score of 2.92409 (Getzoff, 2022).

The development of high technologies in Kazakhstan can be in its infancy. The USA, Japan, the EU countries, as well as Israel are the world leaders in high technologies. It should be recognized that Kazakhstan lags behind them both in terms of absolute indicators of scientific and technological development and in terms of the degree of industrialization and commercialization of the developments of the high-tech industry (Satybaldin et al., 2019).

The purpose of this study is to assess the relationship between project management application processes and project success in the industrial sectors of countries like Israel, Kazakhstan, and Japan. This paper's major objective is to analyze high-tech project management in these three nations' engineering, green manufacturing, chemical, and atomic industries. An evaluation of the chosen countries' project management maturity levels is also included in this research. The research offers a number of recommendations for tools and methods for Kazakhstan's high-tech project management. The statistical study's conclusions indicate that using them to manage high-tech development will aid in the project's successful completion.

2. LITERATURE REVIEW

One of the urgent problems of modern economic science is the organization of effective management of high-tech projects. Despite the high degree of development of high-tech projects in industrial activities, many theoretical and practical provisions remain open for study. The relationship between the evaluation level of the project effectiveness in the industrial sector and the choice of commercial organizations in the direction of innovation development and high-tech areas directly determines the effectiveness of an industrial company.

Many foreign and domestic scientists have studied various theoretical aspects in evaluating the effectiveness of the high-tech project management system. The main definitions and concepts related to the management of high-tech projects and programs are considered in the research of Zwikael O., Jacobs L., Lee J.C., and McCalman D.

The problem of developing high-tech projects of enterprises in the context of developing and implementing their strategies was studied in detail by authors such as Batkovsky A.M., Vikhansky O.S., Akoff R., Ansof I., Drucker P., Kaplan R., Kotler F., Forrester J. and others. The research of such authors as Shapiro V.D., Archibald R., Goldratt I., Diethelm G., Voropaeva V.I., Galperina Z.M., Lishchenko E.N., Mazura I.I., Popova V.L., Razu M.L. etc., revised modern approaches to project management and the features of their implementation in the industry in detail.

Domestic researchers, Adilova A.M., Bolatzhanuly T., Zholdasbaev O., Duysembekova G., Karmazina L., Mukhtarova K.S., Narbaev T., Nekrasova N, Sailaugin A. A.N., Akhmetova Z.B., Tsekhovoi A.F., Abdigapparova S.B. studied Issues of sustainable innovation, some current development trends of the worldwide high-technology and nanotechnology market, features of current development trends of the national economy's innovation-technological sector, innovation system and its infrastructure, innovation policy, subjects of the introduction of innovative technologies to the domestic market.

However, in the studies mentioned above, the conceptual foundations of nanotechnology project management, methodological aspects, evaluation of the organization's maturity level, and ongoing nanotechnology projects needed to be more thoroughly considered. There needs to be more research to analyze nanotechnology projects implemented in the Republic of Kazakhstan. Thus, the above facts prove the relevance and necessity of this study. In conclusion, a significant difference is expressed between the provisions of the theoretical concept of introducing high-tech projects and the actual functioning of industrial enterprises. Also, the research is primarily theoretical and needs a comprehensive approach to managing the transformation of high-tech behavior. Internal factors influencing an enterprise's choice of one high-tech project have yet to be studied in actual industrial activity. Moreover, in Kazakhstan and abroad, there are few studies on the impact of high-tech project management assessment on the performance and efficiency of industrial companies. The leading research is devoted to the state regulation of innovative high-tech projects in activities, analysis of effectiveness and evaluation of indicators for implementing all levels of projects.

Unfortunately, under state regulation, the issues of stimulating the effectiveness of evaluating the management and application of high-tech projects in industrial companies are the least affected. This work allows us to observe the gap between Kazakhstan and other countries in assessing the management of high-tech projects and the effectiveness of the functioning of industrial companies in today's challenging economic conditions.

This work differs from the work of the above authors in that it is the first work on a comparative analysis of the effectiveness of managing high-tech projects in such industries as engineering, green manufacturing, chemical, and atomic industries in Japan, Israel and Kazakhstan and gives recommendations for tools and methods for managing high-tech projects based on the experience of these two successful foreign countries.

3. METHODOLOGY

During the study, quantitative methods were used, such as a survey, statistical data analysis, comparative analysis, etc. A systematic approach to studying the theoretical foundations of high-tech project management was applied Below in Figure 1 is demonstrated the research model that is used to assess the main variables in the project performance of Israel, Japan and Kazakhstan.

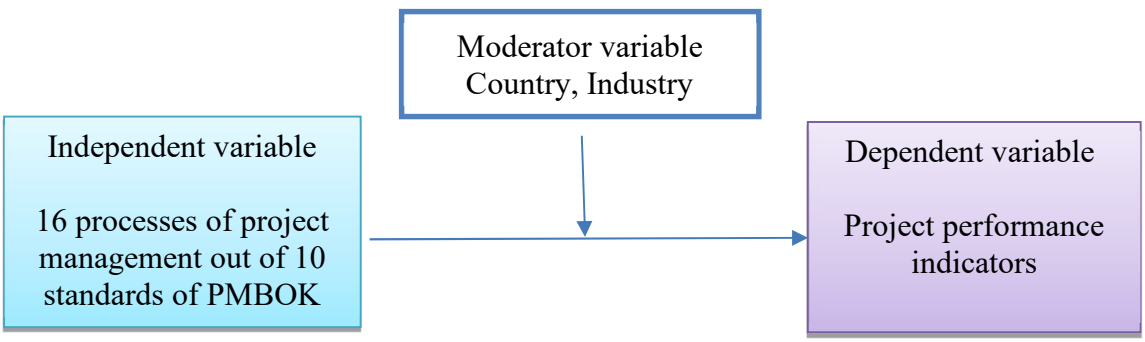

FIGURE 1. Research model

Source: compiled by the authors

According to Figure 1, project management processes, by the standard PMBoK (PMBoK 2017), were chosen as an independent variable, and project performance indicators were considered a dependent variable. The research model incorporates independent factors in the form of 16 planning processes from 10 knowledge domains and dependent variables in the form of time, cost overrun and customer satisfaction. The study analyzes this influence using the intensity of PM planning processes that exist in each PM knowledge area.

Data collection. The data for the research were collected as a survey. It was sent to the 2000 supervisors and project managers through Google Docs, and only 173 of them answered the questionnaire. For the final analysis, 150 answers were selected from them. The survey questions were to define the use of all processes in the countries. After the collection of the answers to the survey, the intensity of use of 16 processes was assessed on a Likert scale from 1 to 5. Obtained performance parameters from project managers were processed in Excel using the analysis of the variance function. The model has been tested and validated for the data's accuracy and validity. The results of the assessment are illustrated in table 1. Engineering, Green production, Chemical industry and atomic industry were selected as the main sectors to assess in the chosen three countries.

TABLE 1. Study sample

Project Sector	**Japan**	**Israel**	**Kazakhstan**
Engineering	28	24	19
Green production	20	41	18
Chemical industry	24	20	21
Atomic Industry	8	5	7
Note: compiled by the authors based on references (Zwikael et al., 2005)			

According to the data from Table 1, Japan is leading in Engineering, Chemical and Atomic Industries, while Israel is at the top in green production. Kazakhstan stands in between these two countries. It is essential to highlight that by the performance parameters, Kazakhstan is ahead of Israel in such indicators as the Chemical and Atomic Industry. It is also important to note that the gap between indicators is not as big as expected. The data for the Japanese and Israeli projects were obtained from a study conducted by Zwikael et al. (2005). Also, the results of the obtained questionnaire were evaluated by SPSS Statistics. Results are significant, according to the validity test for the model are presented in table 3.

4. FINDINGS AND DISCUSSION

A content analysis conducted as part of the study allowed for identifying the characteristics of the usage of knowledge domains by project managers in Japan, Israel, and Kazakhstan (Table 2). These outcomes were also contrasted with the findings of the statistical analysis.

TABLE 2. Maturity level of PM in Japan, Israel and Kazakhstan

No.	Region knowledge of UE	Low significance	High significance
1	Integration Management	Japan	Israel
2	Scope	Japan	Israel
3	Time Management	-	Japan, Israel, Kazakhstan
4	Cost Management	Israel	Japan, Kazakhstan
5	Quality management	Kazakhstan	Japan
6	HR Management	-	Japan
7	Communication Management	-	Japan
8	Risk Management	Japan, Israel	-
9	Procurement management	-	-
10	Stakeholder Management	-	Japan
Note: Compiled by the authors based on references (Zwikael et al., 2005; Globerson & Zwikael, 2002; Dyussembekova, 2016; Lee & MacCalman, 2008; Jonathan et al., 2008)			

As shown in Table 2, Japanese managers are least focused on integration, content and risk management, with an emphasis on quality management, human resources and communications. As for Kazakhstan, compared to Israel, it pays more attention to cost management, leaving quality and risk management without due control. Overall, Japanese project managers are more aware of the region's knowledge of the UE than Kazakhstan and Israel.

The concept that there does not exist a single widely used technique or algorithm for project management is at the core of high-tech project management. The management strategy is determined by the characteristics of a particular circumstance and by evaluating the principles or techniques that will produce the best results under the conditions. Despite this, there are specific processes in the life cycle of any project. Table 3 below demonstrates a comparative assessment of the use of PM processes in Japan, Israel and Kazakhstan.

TABLE 3. Comparative assessment of the use of PM processes in Japan, Israel and Kazakhstan in 2020-2021

No.	PM Processes	PMPQ index/ Japan	PMPQ index/ Israel	PMPQ index / Kazakhstan
1	Defining activities	3.7	4.1	4.0
2	Recruitment	3.3	3.6	2.8
3	Project plan development	3.7	4.0	2.4
4	Resource planning	3.5	3.7	2.9
5	Estimating activity durations	4.0	4.2	3.6
6	Scope planning	3.9	4.1	3.3
7	Procurement planning	2.9	3.0	2.6
8	Organizational planning	3.7	3.8	3.3
9	Risk management planning	2.8	2.8	1.9
10	Quality planning	3.0	2.9	2.6
11	PM sequence planning	3.6	3.7	3.1
12	Project Schedule Development	4.1	4.0	3.8

13	Volume definition	3.8	3.7	3.0
14	Cost budgeting	3.4	3.2	3.4
15	Communication plan	2.9	2.4	1.5
16	Procurement estimation	4.1	3.0	3.2
Note: Compiled by the authors				

According to this table, Israeli project managers outperform Japanese and Kazakh project managers in terms of the intensity of project management processes. According to the data in the table, Kazakhstani managers lag in many positions, such as communication planning, quality and risk management, etc. Moreover, Kazakhstan is behind Japan by 15 indexes, except for the "Defining activities" process.

The project's time and actual cost deviate from those expected due to unforeseen internal conditions and unpredictable changes in the project's external environment. Moreover, the needs for which the project was created may change over time (Archibald 1992). This can lead to low customer satisfaction. The following figure illustrates indexes of four indicators cost overrun, schedule overrun, technical performance and customer satisfaction in Kazakhstan, Israel and Japan (figure 2).

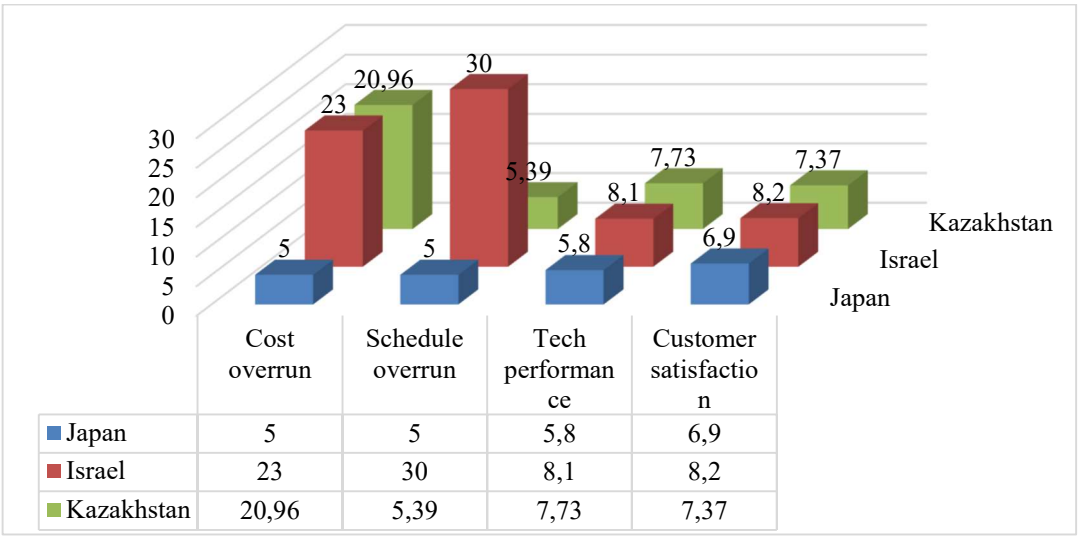

FIGURE 2. Comparative analysis results of the performance indicators of high-tech industrial projects in Japan, Israel and Kazakhstan in 2020-2021 years

Source: Compiled by the authors

As shown in Figure 2, Israel and Kazakhstan have high-cost variances, indicating that industrial projects are over budget. As for the deviation from the deadlines, it can be concluded that Japanese projects are often completed on time. Surprisingly, the lowest customer satisfaction level is observed in Japan, despite the well-established image of a quality-oriented country. The following table presents critical project management processes that have a more significant impact on performance indicators.

TABLE 4. Critical success factors for high-tech initiatives in the Republic of Kazakhstan's manufacturing sector in 2020-2021

PM processes	Chemical industry	Green production	Engineering	Atomic Industry
Developing a project plan	+	+	+	+
Content planning			+	
Scope definition		+	+	+
Defining activities	+			+
Estimating activity durations	+			
Schedule Development		+		+
Resource planning			+	
Cost estimation	+			+
Budget development				
Quality planning	+		+	
Organisational planning				
Recruitment planning		+		
Communication planning	+			
Risk Management planning		+		+
Procurement planning		+		
Stakeholder planning				+
Note: compiled by the authors				

Thus, the statistical analysis allowed us to identify processes that affect cost, timing and customer satisfaction more than other processes in Kazakhstan. The most crucial PM process for all the chosen sectors is "Developing a project plan", and the second, by its importance, is "Defining the project's scope". However, the minor critical processes are "Budget development" and "Organizational planning". This data will allow the focus and resources to be directed to these processes to increase project performance.

Ten knowledge domains are used to create the crucial success processes for each set of high-tech initiatives. Based on the recognized important regions, appropriate PM methods were chosen following the PMBoK standard. Network Diagrams, WBS, Peer Review, the Critical Path Method, Gantt Charts, and Information Systems have all been cited as being crucial for many high-tech projects.

5. CONCLUSIONS

In accordance with the findings of three types of analyses, including maturity level, comparison of the usage of UE procedures, and comparison of performance indicators of high-tech industrial projects in three countries. Kazakhstan is less adept at managing high-tech initiatives than nations like Israel and Japan.

Processes essential to high-tech project success in the industry field were further analyzed, which gives us an understanding of what processes affect the cost, time and customer satisfaction more than other processes. As a result of the data obtained from the statistical analysis, the processes that need to be spent more time in the project's life cycle for Kazakhstan in the field of high technologies is “Developing a project plan”.

The assessment of critical success processes for high-tech projects has allowed the construction of a process algorithm that can be used as a map for each group of projects. Also, the research suggests several tools and methods for successful high-tech project management in Kazakhstan. Their use in the management of high-tech projects will contribute to the successful completion of the project, as shown by the statistical analysis results.

Kazakhstan has the lowest outcomes in terms of project success rate and application of PM techniques. Additionally, the study concludes that a factor in failure is a lack of organizational support. In order to effectively employ PM techniques and methods, Kazakh managers should research international experience. Their project management abilities are enhanced. It may be possible to achieve this improvement by hiring and training certified PMs.

Policy recommendations: It is important for Kazakhstan to understand the experience of international high-tech project management tools in practice. For this reason, attracting foreign managers for experience exchange is necessary. The solution in the short term may be to create incentives, such as support for research and funding for foreign scientists, assistance with relocation to Kazakhstan, and the introduction of favorable migration rules. In the long term, there may be scholarship programs, and partnerships have been established with foreign universities to create a fund to support scientific research and internships.

National cultural differences in all phases of project management are not covered, which is one of the study's limitations. However, the findings may be expanded upon in future research pertaining to the whole project life cycle. Data from a constrained range of nations and sectors are considered in the study. The following studies should look at planning quality in other nations, particularly in developing nations like Kazakhstan, since the literature indicates that there aren't many studies about PM in these nations. Additionally, there is a significant selection of other untapped businesses that might be taken into account in future research.

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