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PREDICTIVE MODEL FOR PERSONNEL ADAPTATION EFFICIENCY IN PROJECT MANAGEMENT

Introduction. *In the context of growing popularity of project-oriented structures, especially in international environments, effective personnel adaptation has become a key factor for successful project implementation. Inadequate adaptation of new employees can lead to project delays, budget overruns, and reduced team performance. This is particularly relevant in international projects where additional challenges include language, cultural, and technological barriers. However, most modern project management tools lack integrated mechanisms for forecasting adaptation efficiency. The proposed model aims to address this gap.*

The purpose of the paper *is to develop a predictive model that assesses personnel adaptation efficiency within project management.*

Results*. The model was tested using the case of the company engaged in international cooperation between Ukraine and China. Based on empirical data, key indicators were normalized, and correlation and regression analyses were conducted to determine the significance of each variable. A Personnel Adaptation Index (IAP) was constructed, ranging from 0 (low adaptation) to 1 (high adaptation). The analysis confirmed that a higher level of initial preparation, more training hours, and increased digital integration positively influence adaptation efficiency. In contrast, a high cultural barrier significantly reduces the adaptation index. The model was tested on hypothetical employee profiles with varying characteristics, confirming its practical value in project environments. Modeling results can be used to predict adaptation success even before hiring a candidate.*

Conclusions. *The proposed model is a universal tool suitable for integration into project management systems and HR analytics platforms. It not only forecasts adaptation outcomes but also supports planning for personalized training, digital support, and mitigation of cross-cultural risks.*

Keywords: *personnel adaptation, project management, predictive model, digitalization, cultural barrier, human resources, international cooperation*

INTRODUCTION

Nowadays project-based organizational structures are becoming increasingly common, especially in international and innovation-driven industries [1]. One of the critical factors for the success of such projects is the efficient integration of newly hired or transferred personnel into project teams [2; 3]. Personnel adaptation is no longer solely a function of human resource management – it has become a vital component of effective project management.

When employees fail to adapt in time, project timelines may suffer, budgets can overrun, and team performance deteriorates [4]. This is particularly true in international projects, where cultural, linguistic, and technological barriers further complicate onboarding processes [5; 6]. Therefore, the ability to predict and manage personnel adaptation efficiency is essential for minimizing project risks and ensuring successful implementation of tasks within scope, time, and quality constraints.

Despite the recognized importance of adaptation, most project management tools lack mechanisms for forecasting how well employees will integrate into project environments. This paper addresses this gap by proposing a predictive model for assessing adaptation efficiency. The model is based on key quantitative and qualitative factors that influence adaptation outcomes and is designed to support data-driven decision-making in personnel planning at the project level.

The **PURPOSE** of the paper is to develop a predictive model that helps project managers evaluate and improve personnel adaptation processes in order to optimize team performance, reduce project risks, and ensure timely delivery of international projects.

RESEARCH METHODS

To develop a predictive model applicable to project management, a combination of quantitative and analytical methods was used. Empirical data were collected from a case study at LLC "NAVEK". The enterprise specializes in wholesale trade of construction materials, wood, and sanitary equipment, while also engaging in the production of plastic construction materials and logistics-related services and operates in international project environments involving Ukrainian and Chinese collaboration [7]. The dataset included four key variables affecting personnel adaptation: initial preparation level, number of training hours, level of digital technology usage, and degree of cultural barrier. All variables were normalized to a 0-1 scale to ensure comparability. Correlation analysis was applied to evaluate the strength and direction of relationships between these variables, while regression analysis was used to construct the predictive formula for the Adaptation Index (IAP). The model's functionality was tested through scenario analysis using hypothetical employee profiles with varying characteristics. The model is designed for practical implementation using tools such as Excel, Python, or project management dashboards, allowing real-time monitoring and decision-making to improve personnel integration in project teams.

RESULTS

In project management, successful adaptation of new personnel is critical for maintaining project velocity and

team cohesion. When employees are effectively integrated, they are more likely to contribute meaningfully to project goals, adhere to project timelines, and communicate efficiently within project teams [8; 9]. This makes adaptation not only an HR function but a strategic project management concern.

The proposed predictive model aims to forecast the efficiency of personnel adaptation was tested on the LLC "NAVEK". This model considers key influencing factors such as:

– the initial level of preparation of employees before joining the company;

– the number of training hours they undergo;

– the level of digital technology utilization in the adaptation process;

– the cultural barrier between Ukrainian and Chinese working environments [7].

The model facilitates the optimization of adaptation strategies by pinpointing the key variables that have the greatest impact on adaptation outcomes. By measuring these factors, organizations can make informed, data-driven decisions to improve the integration of personnel, particularly in international project environments. We propose to measure effectiveness of personnel adaptation using the Adaptation Index (IAP), which ranges from 0, indicating low adaptation, to 1, indicating full adaptation. The predictive formula for calculating this index is as follows:

$$IAP = \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 - \alpha_4 X_4 + \epsilon, \quad (1)$$

where *IAP* – personnel adaptation index (0 to 1, where 1 indicates full adaptation success);

X_1 – initial level of employee preparation (scaled from 0 to 100), should be normalized to a 0-1 scale by dividing by the maximum value (100);

X_2 – number of training hours completed. The number of training hours (ranging from 5 to 50) should be normalized to a 0-1 scale by dividing by the maximum value (e.g., 50);

X_3 – level of digital technology usage (0 to 1, where 1 means full digital integration);

X_4 – cultural barrier (0 to 1, where 1 represents the highest barrier);

α_1, α_2, α_3, α_4 – weight coefficients determined based on empirical data. The weight coefficients are estimated using regression analysis or machine learning algorithms based on real workforce adaptation data;

ϵ – random error accounting for unobserved variables.

To ensure that the model accurately integrates both quantitative variables (such as training hours and initial preparation level) and qualitative factors (such as the level of digitalization and the cultural barrier), a correlation analysis was carried out (Fig. 1). This step was essential for validating the relationships between the selected variables and confirming their relevance within the predictive model.

The correlation matrix provided several important insights for refining the predictive model. First, it revealed that if two variables exhibit a high correlation coefficient (above 0.7), one of them may be statistically redundant and could potentially be excluded to simplify the model without loss of accuracy. A notable negative correlation between the cultural barrier and the Adaptation Index (IAP) clearly indicates that higher cultural barriers significantly hinder the effectiveness of personnel adaptation. In contrast, both training hours and the level of digitalization demonstrated a moderate positive correlation with IAP, suggesting that these factors meaningfully

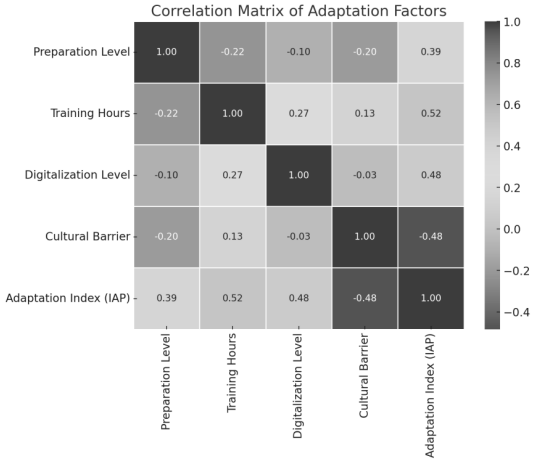

Fig. 1. Correlation Matrix of Adaptation Factors

contribute to smoother and more successful employee integration. Furthermore, the initial level of preparation showed a particularly strong influence on the adaptation index, confirming that individuals with higher base-line knowledge and skills adapt more rapidly and effectively.

Based on these findings, LLC "NAVEK" can strategically enhance its adaptation processes. Training resources can be allocated more efficiently by prioritizing areas with the greatest impact. Investments in digital technologies should be focused where they demonstrably support faster integration. Additionally, targeted initiatives to reduce cultural barriers, – such as mentorship programs, intercultural training, or staff exchange schemes, – can significantly improve adaptation outcomes.

The proposed model serves as a practical forecasting tool for HR managers and project leaders, allowing them to evaluate the likelihood of successful adaptation for new employees even before their formal onboarding. This predictive capability supports proactive measures such as scheduling additional training sessions or assigning mentors to high-risk individuals. Moreover, by simulating different adaptation scenarios, organizations can assess the potential impact of changes in training intensity or digital support, thereby selecting the most effective strategies in advance.

To further validate the model and illustrate its practical application, an empirical test was conducted using hypothetical workforce data. This next step followed the correlation analysis and was aimed at evaluating how variations in key input factors – initial preparation level, number of training hours, degree of digitalization, and intensity of cultural barriers – affect the predicted adaptation outcomes. Through regression analysis, several test cases were developed to simulate real-world scenarios and assess how the model responds to different personnel profiles (Table 1). This allowed for a deeper understanding of the model's predictive power and its usefulness in supporting evidence-based decision-making in project-based human resource management.

The analysis of test cases confirms the model's practical value in forecasting personnel adaptation outcomes. As shown in Figure 2, Employee 3, who had the highest preparation level, longest training duration, and highest digital integration with minimal cultural barriers, achieved the best Adaptation Index (IAP) score of 0.73. In contrast, Employee 2, who had lower preparation, limited training, and faced a high cultural barrier, scored only 0.22, indicating a high risk of unsuccessful adaptation. Employee 1, with intermediate values across the variables, reached a moderate adaptation index of 0.58.

Table 1 – **Test Cases for Workforce Adaptation Prediction**

Employee	Initial Preparation Score	Training Hours	Digitalization Level	Cultural Barrier	Predicted Adaptation Index (IAP)
Employee 1	80	30	0.8	0.3	0.578
Employee 2	60	10	0.5	0.6	0.223
Employee 3	90	40	0.9	0.2	0.730

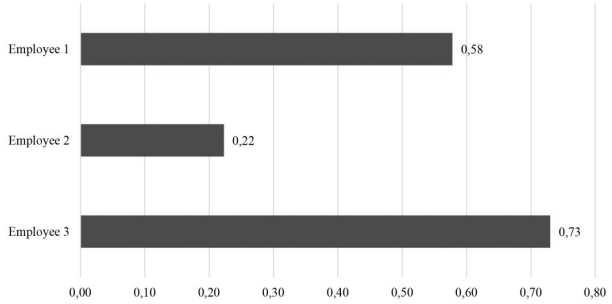

Fig. 2. Predicted Personnel Adaptation Index

These results provide a clear illustration of how the interaction between the selected factors affects adaptation efficiency. They reinforce the importance of investing in employee preparation and training, leveraging digital tools during onboarding, and addressing cross-cultural issues – especially in international project settings. The visual comparison highlights the predictive model's capacity to guide human resource and project managers in making data-driven decisions aimed at minimizing adaptation challenges and optimizing workforce integration within project environments.

The developed model offers a range of practical advantages, especially in the context of integrating personnel into international project teams. By applying data-driven methodologies, HR departments and project managers can make more informed decisions regarding how to allocate training resources and prepare new employees. This ensures that efforts are focused on the most impactful areas, enhancing adaptation efficiency and aligning human resource strategies with project needs.

One of the core benefits of the model is its ability to shorten the adaptation period, which contributes to faster onboarding, improved productivity, and smoother transitions into new roles or project environments. In addition, the model supports cost-effective personnel development by enabling organizations to move away from generic training approaches and instead apply targeted interventions tailored to individual adaptation profiles.

From an operational standpoint, the model is flexible and can be implemented using widely available analytical tools, such as Excel, Python, or specialized HR and project management platforms. These tools can be used to track adaptation dynamics in real time via interactive dashboards, offering insights into employee progress and identifying areas requiring additional support [10]. Importantly, the model is designed to evolve: by incorporating ongoing feedback and updated data, its predictive accuracy and strategic value improve over time.

In the case of LLC "NAVEK", the model has proven to be an effective tool for optimizing the adaptation of personnel within international collaboration projects, particularly those involving Chinese partners. It has enabled the company to reduce the impact of cultural barriers, enhance the onboarding experience, and ultimately improve workforce performance in complex project environments.

Furthermore, the model can be embedded into project dashboards as a critical metric for monitoring onboarding success. This integration allows project managers to forecast adaptation outcomes in advance, assign roles more effectively, and proactively address potential delays or interpersonal frictions – thus strengthening overall project execution and minimizing risks related to human factors.

CONCLUSIONS

The proposed predictive model for assessing personnel adaptation efficiency provides a valuable tool for improving human resource management in project-oriented environments. By identifying and quantifying key adaptation factors – such as training hours, initial preparation, digitalization level, and cultural barriers – the model enables organizations to make data-driven decisions that enhance employee integration. Its application can significantly reduce adaptation time, improve team cohesion, and increase overall project efficiency, especially in international settings where cross-cultural challenges are present.

The versatility and practicality of the model make it suitable for integration into project management systems and HR analytics platforms. As demonstrated through empirical testing, the model not only forecasts adaptation outcomes but also supports the planning and optimization of adaptation strategies. For companies like LLC "NAVEK", operating in cross-border partnerships, such tools are essential for ensuring workforce readiness and minimizing project risks. The model's adaptability to various implementation tools and its capacity for continuous improvement position it as a strategic asset for modern project management practices.

References

1. San Cristóbal J.R., Fernández V., Díaz E. An analysis of the main project organizational structures: Advantages, disadvantages, and factors affecting their selection. *Procedia Computer Science*. 2018. № 138. pp. 791–798. URL: https://doi.org/10.1016/j.procs.2018.10.103

2. Shamim M.M.I. Exploring the Success Factors of Project Management. *American Journal of Economics and Business Management*. 2022. № 5(7). pp. 64–72. URL: https://doi.org/10.31150/ajebm.v5i7.1314

3. Malynovska Y., Bashynska I., Cichoń D., Malynovskyy Y., Sala D. Enhancing the Activity of Employees of the Communication Department of an Energy Sector Company. *Energies*. 2022. № 15(13):4701. URL: https://doi.org/10.3390/en15134701

4. Al-Balawneh K.A., Tarabieh S. The Impact of Risk Management and Knowledge Management on Construction Project Success: The Mediating Role of Project Management Performance. *Mutah Journal of Humanities and Social Sciences (MJHSS)*. 2024. № 39(1). URL: https://doi.org/10.35682/mjhss.v39i1.923.

5. Britto R., Cruzes D.S., Smite D., Sablis A. Onboarding software developers and teams in three globally distributed legacy

projects: A multi-case study. *Journal of Software: Evolution and Process*. 2017. № 30(4). URL: https://doi.org/10.1002/smr.1921.

6. Yanping L., Leli X. Human Resource Management: Integrated Framework and Research Prospects. *Science & Technology Progress and Countermeasures*. 2021. № 38(23). pp. 10-14.

7. Ren X. Peculiarities of human resources management of a Ukrainian manufacturing enterprise under the conditions of cooperation with Chinese enterprises (on an example of LLC «Navek»). Qualification thesis for the Master's degree in Management. Odesa, 2025. 81 p.

8. Zhang Y., Li D. Enhancing Project Performance through Effective Team Communication: A Comprehensive Study Integrating Project Management Quotient, Trust, and Management Information Systems. *Journal of Information Systems Engineering and Management.* 2024. № 9(1). Article ID 25574. URL: https://doi.org/10.55267/iadt.07.14317.

9. Mir F.A., Pinnington A.H. Exploring the value of project management: Linking Project Management Performance and Project Success. *International Journal of Project Management.* 2014. № 32(2). pp. 202–217. URL: https://doi.org/10.1016/j.ijproman.2013.05.012.

10. Grobler-Dębska K., Mularczyk R., Gawęda B., Kucharska E. Time Series Methods and Business Intelligent Tools for Budget Planning – Case Study. *Applied Sciences*. 2024. № 15(1). Article ID 287. URL: https://doi.org/10.3390/app15010287.

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ПРОГНОЗНА МОДЕЛЬ ЕФЕКТИВНОСТІ АДАПТАЦІЇ ПЕРСОНАЛУ В УПРАВЛІННІ ПРОЄКТАМИ

Вступ. *В умовах зростаючої популярності проєктно-орієнтованих структур, особливо у міжнародному середовищі, ефективна адаптація персоналу стала ключовим чинником успішної реалізації проєктів. Недостатня адаптація нових працівників може призводити до зривів термінів, перевищення бюджету та зниження продуктивності команди. Це особливо актуально для міжнародних проєктів, де додатковими викликами є мовні, культурні та технологічні бар'єри. Проте більшість сучасних інструментів управління проєктами не має вбудованих механізмів прогнозування ефективності адаптації персоналу. Саме цю прогалину і покликана заповнити запропонована модель.*

Метою *статті є розроблення прогнозної моделі, яка дає змогу оцінити ефективність адаптації персоналу в управлінні проєктами.*

Результати*. Для реалізації моделі застосовано кейс підприємства, що працює у сфері міжнародного співробітництва між Україною та Китаєм. На основі емпіричних даних нормалізовано ключові показники та проведено кореляційний і регресійний аналіз для визначення значущості змінних. Побудовано індекс адаптації персоналу (IAP), що варіюється від 0 (низька адаптація) до 1 (висока адаптація). Аналіз підтвердив, що вищий рівень початкової підготовки, більша кількість навчальних годин та активне застосування цифрових технологій позитивно впливають на ефективність адаптації. Натомість високий культурний бар'єр істотно знижує значення індексу адаптації. Проведено тестування моделі на гіпотетичних профілях працівників з різними характеристиками, що підтвердило її практичну цінність у проєктному середовищі. Результати моделювання можуть застосовуватися для прогнозування успішності адаптації до фактичного прийняття працівника на роботу.*

Висновки*. Запропонована модель є універсальним інструментом для інтеграції у системи управління проєктами та HR-аналітики. Вона дає змогу не лише прогнозувати результати адаптації, а й планувати персоналізацію навчання, цифрову підтримку та мінімізацію міжкультурних ризиків.*

Ключові слова: *адаптація персоналу, управління проєктами, прогнозна модель, цифровізація, культурний бар'єр, людські ресурси, міжнародна співпраця*